ANNUAL REPORT, DEPARTMENT OF THE ARMY

Fiscal Year Ended June 30, 1963

U.S. Army. Corps of engineers.

ANNUAL REPORT OF THE

CHIEF OF ENGINEERS,

U.S. ARMY

ON CIVIL WORKS ACTIVITIES

1963

IN TWO VOLUMES

Vol. 1 - 2

U.S. GOVERNMENT PRINTING OFFICE

WASHINGTON : 1964

For sale by the Superintendent of Documents, U.S. Government Printing Office
Washington, D.C., 20402 - Price 45 cents

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE **1963**	2. REPORT TYPE	3. DATES COVERED **00-00-1963 to 00-00-1963**
4. TITLE AND SUBTITLE **Annual Report of the Chief of Engineers, U.S. Army on Civil Works Activities 1963**		5a. CONTRACT NUMBER 5b. GRANT NUMBER 5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)		5d. PROJECT NUMBER 5e. TASK NUMBER 5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **U.S. Army Corps of Engineers,Omaha District,441 G Street NW,Washington,DC,20314-1000**		8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)		10. SPONSOR/MONITOR'S ACRONYM(S) 11. SPONSOR/MONITOR'S REPORT NUMBER(S)
12. DISTRIBUTION/AVAILABILITY STATEMENT **Approved for public release; distribution unlimited**		
13. SUPPLEMENTARY NOTES		
14. ABSTRACT		
15. SUBJECT TERMS		

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a REPORT **unclassified**	b ABSTRACT **unclassified**	c THIS PAGE **unclassified**	**Same as Report (SAR)**	**157**	

CONTENTS

Volume 1

Volume 2

Reports on individual project operations and related Civil Works activities published as a separate volume. For sale by Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. Price $5.25.

Statistics on Waterborne Commerce of the United States are printed separately. (See ch. VI, sec. 9.)

SUBJECT: Annual Report on Civil Works Activities for Fiscal Year 1963

TO: THE SECRETARY OF THE ARMY

1. The water resource development program of the Corps of Engineers includes the investigation, design, construction, and operation and maintenance of works for naviagtion, flood control, hydropower, water supply, water quality control, recreation, fish and wildlife preservation, shore protection, and other water resource uses authorized by law.

2. Volume 1 of my annual report presents a summary of status and accomplishments, changes in policies, improved techniques, and planning to meet long-range future water requirements. It also provides, in appendices, a ready reference to summary data on water resource development by the Corps, regionally and nationwide.

3. Volume 2 contains detailed information on individual projects and programs. Detailed tabulations and national summaries of waterborne commerce are published separately.

4. The active Civil Works program consists of about 3,600 project authorizations with a total estimated cost of $22 billion. Appropriations through fiscal year 1963 for new work totaled about $12 billion, leaving about $10 billion still required. Appropriations during fiscal year 1963 were $1,046 million, of which $846 million (81 percent) was for construction.

5. This program continues to provide large and widespread benefits to the Nation. Items of major significance are:

(*a*) *Navigation.* Commerce on the Great Lakes during calendar year 1962 amounted to 90 billion ton-miles, and on the inland and intracoastal waterways system, 133 billion ton-miles. These two segments of our national transportation system carried about 15 percent of the Nation's intercity ton-mileage of freight. Total waterborne traffic of the United States amounted to 1,129 million tons, of which the distribution to coastal harbors and channels, Great Lakes harbors and channels, and inland and intracoastal waterways was 47, 16 and 37 percent, respectively.

(*b*) *Flood control.* Flood damage prevented by projects in operation is estimated to total nearly $12 billion, including more than $525 million during fiscal year 1963.

(*c*) *Hydropower.* Corps of Engineers hydroelectric power activities, which began with operation of a 1,800-kilowatt plant on the St. Marys River, Mich., in 1909, have grown into a program involving the operation of over 8.2 million kilowatts of installed capacity, with the generation of 30 billion kilowatt-hours of energy during the fiscal year. The generating capacity in operation constitutes about 21.5 percent of the national hydroelectric capacity, and 4 percent of the total generating capacity (hydro and thermal). About the same percentages are applicable to the energy generated.

(*d*) *Water supply.* The Corps provides about 1.6 million acre-feet of storage for water supply in 23 reservoirs, which supplements the water supply for over 2 million people in 67 cities, towns, and rural areas. A dependable supply estimated at more than 1,200 million gallons per day is available from storage now in operation. About 5 million acre-feet of storage space is being utilized, either exclusively for irrigation, or jointly for irritation and other purposes. Large quantities of water made available by power releases and evacuation of flood control storage improve the quantity and quality of downstream flows.

(*e*) *Public recreation use.* Both reservoirs and navigation projects furnish excellent opportunities for public outdoor recreation use. Attendance was 127 million during calendar year 1962, an increase of 6 percent over the preceding year.

6. Continued attention is being given to improving the planning and execution of a well-balanced program for optimum development of water and related land resources as a significant factor in promoting regional and national economic growth.

W. K. WILSON, JR.
Lieutenant General, USA
Chief of Engineers

Item	Fiscal years, except as noted otherwise														Cumulative through 1963
	1963	1962	1961	1960	1959	1958	1957	1956	1955	1954	1953	1952	1951	1950	
I. APPROPRIATIONS [1] ($ millions):															
A. New work: [2]															
1. Navigation	224	204	211	209	190	141	135	88	42	25	31	47	48	60	3,611
2. Flood control	354	325	286	286	278	226	212	143	91	82	148	151	173	231	4,649
2a. Flood control, Mississippi River and tributaries [3]	53	55	55	52	52	44	47	37	31	37	45	46	47	52	1,293
3. Multiple-purpose including power	267	237	258	215	190	126	157	211	204	208	272	278	296	240	3,927
4. Beach erosion control	1	1	1	1	1	-----	1	3	-----	-----	-----	1	-----	-----	10
Subtotal, new work	846	767	756	711	659	493	505	445	337	315	451	477	517	531	12,197
B. Other work [4]	200	204	180	162	157	146	134	167	107	112	111	140	102	110	3,769
C. Total (A+B)	1,046	971	936	873	816	639	639	612	444	427	562	617	619	641	15,966
II. NAVIGATION (calendar year):															
A. Commerce (billions of ton-miles):															
1. Coastal harbors and channels:															
1a. Foreign	(Not available, since much of this commerce moves via open-sealanes)														
1b. Domestic deep-draft	-----	318	312	313	314	305	300	307	309	(5)	(5)	(5)	(5)	(5)	------
2. Great Lakes harbors and channels	-----	90	87	99	80	80	117	111	119	91	127	105	120	112	------
3. Inland and intracoastal waterways	-----	133	123	121	117	110	115	109	98	83	75	64	62	52	------
Subtotal (2+3)	-----	223	210	220	197	190	232	220	217	174	202	169	182	164	------
B. Traffic (millions of tons):															
1. Coastal harbors and channels	-----	534	502	514	497	480	522	498	437	377	374	379	388	324	------
2. Great Lakes harbors and channels	-----	177	172	191	166	158	217	211	216	171	222	188	211	199	------
3. Inland and intracoastal waterways	-----	418	388	395	389	367	392	384	363	320	328	321	325	298	------
Total	-----	1,129	1,062	1,100	1,052	1,005	1,131	1,093	1,016	868	924	888	924	821	------

See footnotes at end of table.

Highlights—Corps of Engineers Water Resources Development—Continued

Item	Fiscal years, except as noted otherwise														Cumulative through 1963
	1963	1962	1961	1960	1959	1958	1957	1956	1955	1954	1953	1952	1951	1950	
III. FLOOD DAMAGES PREVENTED ($ billions) (cumulative)	11.8	11.3	10.6	9.7	9.2	9.0	8.7	8.2	7.8	7.3	6.6	6.0	5.3	4.9	11.8
IV. POWER:															
A. Installed (millions of kw) (cumulative)	8.2	7.5	6.9	6.6	6.1	5.6	4.8	4.0	3.2	2.5	1.7	1.2	1.0	0.8	8.2
B. Generated (billions of kwh)	30.0	29.9	27.2	27.9	26.8	27.2	22.6	18.1	12.6	8.9	6.9	7.1	5.2	4.7	285
V. OTHER RELATED USES:															
A. Water supply and irrigation storage (million acre-feet) (cumulative)	6.6	6.3	5.5	5.5	5.5	5.2	5.0	5.0	4.9	4.2	2.7	2.0	1.0	1.0	6.6
B. Attendance (millions) (calendar year)	------	127	120	109	107	95	85	71	63	54	41	30	21	16	------
VI. RESERVOIR STORAGE (million acre-feet) (cumulative)	176	169	164	162	155	153	150	144	120	115	87	74	60	57	176

[1] Includes about $500 million expended on deferred-for-restudy, inactive, abandoned, or superseded projects.

[2] Advance engineering and design, and construction.

[3] Included in 2.

[4] Operation and maintenance, surveys, administration, and miscellaneous.

[5] Not available.

WATER RESOURCES PROGRAM MANAGEMENT [1]

by

WENDELL E. JOHNSON*

Chief, Engineering Division, Directorate of Civil Works, Office of the Chief of Engineers, U.S. Army

The Water Resources program of the Army Corps of Engineers is one of high investment to improve agriculture, industry, and cities through the management of water. Just as in any properly operated business, the principles of good management must be applied to ensure effective results with the most economical use of men, materials, and equipment. The principles comprise the establishment of planned objectives, the application of proper organization and sound procedures, the use of qualified personnel and adequate facilities, the establishment of performance standards, and the provision of means for effective appraisal of results.

Scope of the Project

The Water Resources program is nationwide in scope, covering virtually every major river basin. The first step is the planning of river basin development to meet the particular requirements of the area involved and yet conform to the policies and standards of the Government. Among project requirements may be such considerations as transportation; hydroelectric power; fish and wildlife conservation; irrigation; stream pollution; water supply for municipal, domestic, and industrial purposes; stream flow regulation; water quality control; flood control; flood plain zoning; navigation on inland waterways, the Great Lakes, and coastal harbors; erosion and nourishment of beaches; and many related fields including soil conservation and watershed treatment.

The management and conduct of the project require cooperation with some 25 different Federal agencies, 500 state agencies, and countless local bodies, quasi-public entities such as levee boards and irrigation districts, trade associations, and many other kinds of private enterprise.

Since there may be from 5 to 30 years between the conception and completion of a basin development, and since the projects must serve for many decades, consideration must be given not only to immediate conditions but also to the situation that may exist in the future. Forecasting the scope and nature of the economic development of a river basin is a primary step in forming a comprehensive plan.

Studies made for the Senate Select Water Resources Committee indicate that the amount of reservoir water-storage capacity will have to be doubled in the 20-year period ending in 1980 to accommodate national growth. Under present statutory responsibilities the Corps of Engineers can expect to be charged with a major portion of this work. It is estimated that within the next 17 years the Corps will have to build about $14 billion worth of reservoirs, install 33,000,000 kilowatts of new hydroelectric generating capacity, provide $2 billion worth of local flood protection works, improve 10,000 miles of existing inland waterways, build 3,000 miles of new waterways, invest $1.8 billion in harbor construction and provide recreational opportunities for an attendance of about 300 million per year—more than double the present amount. To accomplish these tasks, the program will have to be expanded from the present rate of $1-billion-per-year to about $2½ billion a year by 1980.

*Adapted from paper presented by the author at the "Engineering Management Symposium" of The Society of American Military Engineers, May 20, 1963.

Planning

The amount of water existing on the surface of the United States is fixed within relatively narrow areas. There is far more water than is needed but it is not distributed according to requirements. In some areas there are alternating floods and droughts; in others, pollution; and in still others vast quantities of water flow to the sea unused. There must be sufficient control over the national supply of surface water so that it can be made available for use when and where needed. Meeting this problem involves many elements not under the control of one agency. It requires planning and cooperation to an unprecedented degree.

The main means for controlling water in a river basin is the reservoir, which makes it possible to store water in time of high flow, to maintain stream flows and navigation channels; to generate hydroelectric power; and to manage and distribute stored water as and where needed.

In some areas reservoir sites are naturally scarce; in others, dense population and industry deny the use of potential reservoir sites; and in still others, sites are available, but the people in the area prefer to hold the land for scenic, agricultural, or other purposes.

Each river basin offers many alternative possibilities for water storage and control. One combination might be best from the engineering standpoint; another from the economic standpoint; and still another from the standpoint of public preference and acceptance. One might best serve immediate needs while another would be preferable for the long run. Thus, comprehensive river basin plans must take into account all purposes, potentialities, and needs, and all relevant means of development must be utilized.

This is a tremendous task for the Corps of Engineers, which will be responsible for a large portion of the program. This planning combines elements of research, community relations, engineering, and economics to produce an optimum program to meet the needs of the people of each area. Indicative of the importance with which the assignment is viewed by the Chief of Engineers is his establishment of the position of Deputy Director of Civil Works for Comprehensive Planning, headed by a general officer. And throughout the Corps divisions and districts, planning staffs are being expanded. Experts in many fields are being recruited and trained for the planning role. Consideration is being given to the use of electronic computers in evaluating multiple choices of development possibilities. Also, intensified efforts are being made to build up contacts with the other agencies and interests involved in the resource development task, to ensure that all viewpoints are considered.

Mechanics of Management

A basic aspect of the management of the program is the principle of decentralization—the delegation of maximum authority downward—consistent with adequate control. Since 1822 this has been one of the keys to the Corps management system. To conduct the civil works and military construction programs, there are 43 Army Engineer district offices which are the principal contracting and construction units. Their work is supervised and coordinated by 12 division offices, reporting directly to the Chief of Engineers, who provides policy guidance and represents the Corps before the Congress. This decentralized organization makes possible the preparation of comprehensive plans for several hundred different areas and projects, by men in each area who are familiar with local requirements, all operating within one overall program and guided by one set of rules and principles.

Financial control is another salient management feature. Years before the General Accounting Office and the Bureau of the Budget were established, the

Engineers were operating under a cost accounting system. Later, a "performance budget" was added under which all funds required for a specific item of work were requested in a single budget, all costs were applied to that work, and actual costs were held within the budgeted amounts. This performance budget was and still is controlled through detailed advance planning prescribed in 6-year programs, which help to establish work priorities, develop construction schedules, and organize work in terms of types and geographical distribution. Thus, annual requests for funds are based on soundly conceived engineering plans. There is also an internal audit system, a system of financial property accounting, and an "industrial fund accounting system," under which equipment, warehouse stocks, and accounts payable and receivable are held on a Corps-wide basis, with each project charged for the services it receives from the central account. The financial controls are supplemented by systems of manpower controls, a reports system, and a management-improvement program in which all employees may participate. In the 7 fiscal years 1956–62, more than 15,000 management-improvement projects were completed on civil and military programs, resulting in savings of about $126 million.

Although the construction work of the Corps of Engineers is constantly increasing, supervision and administration costs are being constantly reduced. The reductions are Corps-wide: each of the 10 continental divisions showed lower overhead costs during the past year. This is strong evidence that these management programs are generally successful.

The decentralized organization, the financial controls, and the reporting and improvement systems constitute the mechanics with which the Corps manages its operations.

The national program for water resources development necessarily involves many fields of action, but basically the task is one of engineering. Almost 100 manuals on engineering and design subjects relating to civil works and about 70 guide specifications have been issued by the Office of the Chief of Engineers to provide general guidance and reasonable standardization to field offices. The design memorandum system is the main management tool for central review and control of detailed engineering work. A design memorandum containing the recommended general plan for development of a given project is prepared by the district engineering staff, reviewed by higher authority and, when approved, becomes the basis for further detailed design, planning, and specification work. On a complex project, additional feature design memoranda may be prepared. This system permits central review of the main features of project engineering, eliminates review of small details, and makes possible the commencement of work before detailed designs of complicated components are finished.

For many years the Corps has been committed to competitive bidding on civil works construction This is followed in all but the most exceptional circumstances. This may require more care and more detailed engineering and specifications, but competitive bidding also produces greater efficiency in results.

In the continuing search for more efficient management the Corps has installed electronic data-processing equipment in most of its district and division offices for use in dredging, earthwork, structural design, hydraulic and hydrological operations, and other activities. Preparations are being made for the use of such equipment on powerplant and reservoir operations. On one job, the relocation of a railroad in the Pacific Northwest, an exploration of alternatives with computers helped to eliminate about 5 million cubic yards of rock excavation.

Increasing interest is being devoted to the critical path techniques of work programing in order to improve the water resources design and planning work,

to enable the staffs to administer construction contracts more efficiently, and to help contractors improve their own performances. The method, the network analysis system, which includes the Critical Path Method (CPM) [2] and Project Evaluation and Review Technique (PERT), [2] and other similar variations, has already been used successfully by the Corps on other projects.

The water resource programs are a basic part of the economic system on which the prosperity of the United States depends. The degree to which the country can realize benefits from its fixed supply of water will help significantly to determine the direction and extent of the national growth.

---

[2] See "Computerized Project Network Analysis," by Glenn L. White, and "What Electronics Can Do For Management," by Sidney S. Green [M.E. July-Aug. 1963].

VICKSBURG, THE MISSISSIPPI, AND THE U.S. ARMY [1]

by

MAJ. GEN. ELLSWORTH I. DAVIS

U.S. Army

It would be difficult to exaggerate the importance of the Mississippi River to the United States, whether in 1541, when it was discovered by de Soto; 1705, when the first shipment of bear skins was floated down its broad waters; 1811, when the *New Orleans*, the first steamboat, moved down the Ohio and Mississippi to tidewater at New Orleans; 1853, during the steamboat heyday; 1863, when a divided nation struggled for its control; or 1963, today.

Any one year in the life of the Mississippi can find a parallel or comparison with another. In 1541, de Soto first saw it, in flood, "twenty leagues on each side of the river." Each spring since, the river has flooded. The only difference now is that the floodwaters are controlled by massive levees, headwater dams, and floodways. Because of manmade protective works, no general inundation of the alluvial valley of the Lower Mississippi River has occurred since 1927, the year of its most disastrous flood.

Early Navigation and Flood Control

The steamboat marked the real beginning of Mississippi River commerce. It made upstream transportation possible. The steamboats, the workhorses of the valley for 130 years, have given way to the more powerful diesel-engined towboats that push 50 barge tows of 40,000 or more tons for hundreds of miles without stopping to be refueled or restocked. Each year sets a new high record of commercial transportation, which in 1961 reached a peak of more than 136 million tons being carried.

The Mississippi River and its tributaries had provided avenues of travel and commerce for the explorer, the colonizer, and the trader for over a century when the Civil War broke out. During that war, and particularly the Vicksburg Campaign of 1863, the real importance of this great river to the nation was fully realized.

At that time, control of the Mississippi by the Union meant splitting Texas, Arkansas, and half of Louisiana from the Confederacy. It meant opening up the natural outlet to the world for the products of the Middle West. The South fought to prevent this—the North to achieve it. And Vicksburg occupied a key position for its control. Thus, when Vicksburg surrendered on July 4, 1863, the Union gained clear-cut control of the Mississippi. Now, 100 years later in 1963, the U.S. Army is still in Vicksburg. Its engineers are in charge of controlling the Mississippi—this time by peaceful means.

But long before the Civil War the significance of the river was recognized. Federal planning to improve the Mississippi River was begun in 1821. Then in 1824, Congress authorized the removal of trees, snags, drift, and other obstructions from the channels of the Ohio below Pittsburgh and the Mississippi below the mouth of the Missouri River. Capt. Henry Shreve gained prominence at this time by designing and constructing snagboats especially for this purpose. And not the least part of channel maintenance was the salvaging of sunken or stranded steamboats.

The 1849 and 1850 floods created widespread damage in the Mississippi Valley. The floods and the growing river commerce created a demand for increased Federal participation in navigation improvements and flood protection. Surveys

and reports on this subject were made by a number of authorities. The most comprehensive survey was by Capt. A. A. Humphreys and Lt. H. L. Abbott,[2] of the Army Topographical Engineers, published in 1861. They turned the Mississippi into a giant laboratory for their unprecedented experiments. They made their own equipment, worked out new formulas about waterflow and its erosive effects on the land, surveyed the river from Cape Girardeau to the Gulf of Mexico, measured velocity of currents at many points, and studied movement of material on the bottom. They proposed a system of levees and other works to control the lower Mississippi River; their report still remains a classic of river engineering.

Some levees existed at the time of the Civil War, constructed largely by plantation owners on their own land. Averaging less than 5 feet in height, they were effective to a degree but insignificant compared with the levees of today which average 20 to 25 feet in height. The Civil War put an end to navigation improvements and flood protection of the valley, and all such work came to a standstill. Private and State levees were not maintained and many were completely destroyed by floods and by the contending armies. The increase in river commerce brought about by the steamboats had reached its peak between 1850 and 1860. This traffic, except for the movement of vessels of war, was halted by the Civil War.

In mid-1862, virtually the only vessels moving on the river were Union ironclads and supply ships. Only Vicksburg and Port Hudson stood in the way of complete Federal control of the river; Memphis, Baton Rouge,, and New Orleans had already fallen. Situated on a bluff about 200 feet above the Mississippi at its confluence with the Yazoo River, Vicksburg commanded a deep hairpin curve in the river, was unapproachable by land from the west and nearly inaccessible from the north because of the wide mud flats and tangled jungle which formed the Yazoo Delta.

Grant's River Plans

In the fall of that year, Grant began his campaign against Vicksburg, the key to the river. His opponents outnumbered him initially, but they were not united under a single determined and capable commander. The final showdown at Vicksburg was with Lt. Gen. John C. Pemberton. In the ensuing campaign, Union and Confederate forces, weak in engineer troops, fought an engineers' war: they attempted river diversions, dredged, fought floods, built roads and bridges through the swamps, launched amphibious operations, built fortifications, and attacked them by sap, mine, and other classic siege operations.[3]

Three of Grant's plans of attack involved attempts to make the river do what he wanted it to; they were all unsuccessful.

His first plan was to induce the Mississippi River to bypass Vicksburg entirely, so that it would be possible to transport needed men and equipment below the well-guarded city. This he attempted to do by excavating a channel across the relatively narrow neck of the river bend opposite Vicksburg, which has since been cut off naturally by the river itself. But the river stage fell during the operations, his excavation equipment was not adequate to complete the cutoff channel to the depth required for the lower river stage, and the project failed.

The second plan to bypass Vicksburg involved a cutoff and the use of a distributary channel, this time about 50 miles above Vicksburg. Grant was

---

[2] See "First Step in Big River Hydraulics," by L. W. Mosby (M.E. July-August 1961).

[3] See "Vicksburg—A Pattern for Modern War," by Maj. John C. Burney, Jr. (M.E. November-December 1961); and "Ewing's Approach in the Siege of Vicksburg," by Edwin C. Bearss (M.E. January-February 1962).

enthusiastic about this plan. He saw that Lake Providence emptied into the Mississippi through the Tensas, Washita, Black, and Red Rivers, all of which were navigable to within a few miles of the place he had selected for the cutoff. By a little digging (less than a quarter of that that had been done across the point before Vicksburg), he expected to connect the Mississippi and the lake, which he hoped would wash a channel in a short time. But this project accomplished nothing.

The third plan involved cutting a levee, this time far up on the eastern side of of the river a few miles below Helena, Ark., at Yazoo Pass. The plan was to cut the levee which blocked the pass and let the Mississippi floodwaters enlarge the channel so that it would be possible to move gunboats and transports down the Yazoo River and get in behind some of the Vicksburg fortifications. But this scheme also was a failure.

Grant finally succeeded in controlling the Mississippi for the Union by capturing Vicksburg through a daring feat of running gunboats past the Confederate batteries, marching troops southward through the Louisiana swamplands to below the city, crossing the river, defeating separate Confederate forces in detail, and driving Pemberton into the city which Grant then took by siege. Port Hudson fell soon thereafter.

Grant's control of the Mississippi was only skin deep; the Father of Waters was really not under his or anyone's control. Grant and his army did not have the means, the knowledge, or the skill to do that. Control of the waters was to become one of the major campaigns of all time to make the maximum use of and to provide protection against the water flowing in this river whose vast drainage area extends from New York to Montana and to the Gulf of Mexico.

Later Development

After the war, the paddle-wheeled packet continued to be the principal means of transportation on the Mississippi until the latter part of the 19th century, but the rapid expansion of the railroads prevented river navigation from regaining its prewar status. It took two World Wars to demonstrate the need for a revival in river traffic.

Today, the Mississippi is the main stem of a network of inland waterways 17,000 miles long, including the Gulf Intracoastal Waterway and its connecting channels. In 1961, over 72 billion ton-miles of traffic were moved on this system.

The headquarters of the organization charged with controlling the Mississippi is at Vicksburg. It is the Mississippi River Commission of the Army Corps of Engineers, established in 1879. Its second president, Brig. Gen. Cyrus B. Comstock, as a young captain, served as Chief Engineer in Grant's Army during part of the siege.

Through a combination of levees, floodways, upstream reservoirs, and channel shortening and improvement, the Mississippi is controlled as never before. But man will never be able to complete the project and leave it unattended. The river is like a wild animal that, although trained, will revert to its native habits if not constantly watched and corrected.

The alluvial valley of the Mississippi, once subject to annual flooding, left many low areas swampy, unhealthy, and unproductive. Now, with drainage and flood protection, the valley is a fertile and prosperous farming area. And its economy is not wholly agricultural; large areas are devoted to industry, particularly in St. Louis, Memphis, Baton Rouge, and the reach between Baton Rouge and New Orleans, where the investment of riverside industry is in excess of $2 billion. It is expected that this industrial growth will continue with further improvements in drainage, flood control, and navigation.

Vicksburg and the surrounding area on the Mississippi have more than 250 years of recorded history. For 150 years before the Civil War the hills along the river were the scene of a long and exciting struggle between world powers for dominance on this continent. France, Great Britain, Spain, and finally the new nation, the United States of America, realized the value of the Mississippi in peace and in war.

One hundred years ago, with the fall of Vicksburg, Union control of the Mississippi River served further to separate an already divided nation. Today the river serves as an economic link connecting north with south and east with west—and the United States with the world.

THE BLACK WARRIOR-TOMBIGBEE WATERWAY PROJECT

by

JOSEPH E. HUTTON

U.S. Army Engineer District, Mobile, Ala.

The Black Warrior River is formed by the confluence of the Locust and Mulberry Forks about 20 miles west of Birmingham and flows southwesterly 176 miles to join the Tombigbee River at Demopolis, Ala. Thence the Tombigbee flows south about 185 miles, uniting with the Alabama River to form the Mobile River 45 miles above the head of Mobile Bay.

In early days, when rivers were the only means of transporting heavy commodities, packet boats traveled between Mobile and Demopolis most of the year, and during high water they could travel up the Black Warrior for about 130 miles to Tuscaloosa. In 1871, Congress authorized the first Federal work on the waterway itself, which consisted of improving the Tombigbee River below Demopolis by the removal of snags and obstructions, and the widening and deepening of the channel through various shoals. In 1879 a project was adopted which provided for a channel of navigable width and 4 feet deep at ordinary low water from the mouth of the Tombigbee River to Demopolis, a distance of about 185 miles, by the removal of snags and overhanging trees, and by dredging through the worst bars. The original project for the improvement of the Black Warrior River from its mouth to Tuscaloosa was adopted by the River and Harbor Act of 1875, which contemplated deepening the channel by jetty construction and the removal of snags and overhanging trees. Work under this authorization was initiated in June 1875.

At and above Tuscaloosa the river was not navigable due to the presence of rock shoals in the channel. The original project for improvement of this reach was adopted by Congress in 1886, the object being to obtain a year-round channel for barges of 6-foot draft for 14 miles between Tuscaloosa and Daniels Creek by means of locks and dams. Construction of the first lock was commenced in 1888 and three had been completed by 1895. Under subsequent authorization and appropriation acts, 14 additional locks and dams, one a double lift structure, were constructed to provide an all-season, slackwater channel 6 feet deep from Mobile to the vicinity of Birmingham. The last of the series was completed in 1915.

The original 18 locks all had chamber widths of 52 feet and clear inside lengths of 282 to 287 feet. Lifts varied from 8.5 to 21 feet at all except the uppermost structure, which had a total lift of 63 feet divided between two locks in tandem. Overall lift, Mobile to the vicinity of Birmingham, was 244 feet. Four of the locks were constructed of sandstone masonry and the remaining were of concrete. The first three dams to be built were timber cribs filled with stone and the fourth was stone. The remaining dams were either of concrete or timber cribs filled with stone, depending on foundation conditions.

The 1935 River and Harbor Act authorized modification of the project to provide for increasing the channel depth to 9 feet and width to 200 feet where practicable, and to extend the upper limits further upstream. The work was accomplished by dredging, by raising the dams or installing temporary flashboards, by installing 12-foot crest gates at John Hollis Bankhead Dam, and by replacing three locks at and above Tuscaloosa with a single lock and dam (William Baker Oliver lock and dam), the lock having chamber dimensions of 95 by 460 feet. The modification was completed in 1939.

As commerce developed on the river and towing equipment improved, with the advent of larger, multiple barge tows, it soon became evident that the original low-lift locks with inadequate chamber dimensions should be replaced with larger structures better designed to handle the volume and type of traffic using the waterway. Studies indicated that locks with chamber dimensions of 110

722-373—64——2

by 600 feet, comparable to those on the Ohio River, should be provided to meet the requirements of waterway traffic. The first structure to be built under the modernization program was the Demopolis lock and dam, authorized in the 1945 River and Harbor Act and completed in 1954, to replace locks 4, 5, 6, and 7. Subsequent replacements were, or will be, accomplished under authority of section 4 of the 1909 River and Harbor Act, which authorizes reconstruction of obsolete structures. Jackson lock and dam, which replaces locks 1, 2, and 3, was opened to navigation in 1960. Warrior lock and dam, replacing locks 8 and 9, was opened in 1957. Holt lock and dam, which will replace locks 13, 14, 15, and 16, is under construction and scheduled for completion and in operation at full pool during fiscal year 1967. Feasibility report on replacement of the double-lift lock at the John Hollis Bankhead project (lock 17) was commenced in fiscal year 1963. When completed as now planned, the project will consist of 120 miles of open river channel from Mobile to the vicinity of Jackson, Ala., and 6 locks and dams to overcome the lift of 255 feet for the remaining distance to the vicinity of Birmingham. Individual lifts range from 22 feet at Warrior lock and dam to 69 feet at the planned replacement of John Hollis Bankhead lock. Overall length of the project, including the portions in Mulberry, Sipsey, and Locust Forks, is 463 miles.

Use of the waterway has increased steadily and today it is considered to be one of the most important water routes in the Southeast. Tonnage increased from about 2 million tons in 1939, when the 9-foot-deep modification was completed, to over 6 million tons in 1962. Principal items conveyed consist of coal, petroleum and products, crushed limestone, iron ore, clays and earth, sand and gravel, industrial chemicals, pulpwood and logs, iron and steel products, sulfur, and manganese ore.

At present about 30 towing companies operate on the river. Carrier equipment consists generally of towboats ranging up to 1,300 horsepower and barges ranging from 25 by 140 feet to 50 by 280 feet. The smaller barges are operated in towing units of up to 11 barges, for through trips, with 14-barge tows operating in certain reaches. Cargoes average 8,800 tons for the latter size tow. The 50- by 280-foot barges are usually made up into towing units of 2 each, with a cargo capacity of about 5,400 tons per tow.

The existing project for the Black Warrior-Tombigbee River was developed primarily for navigation. However, the Alabama Power Co. has completed the Lewis Smith Dam on Sipsey Fork and is constructing a powerplant at the John Hollis Bankhead Dam. It also has applied for a license to construct one at Holt lock and dam. The Warrior River Electric Cooperative Association has commenced construction of a dam on Locust Fork and has been granted a license for a second dam on that stream.

There is no doubt that improvement of the waterway has played a major role in the development of new industries, and in the expansion and revitalization of those in existence at the time improvement was first undertaken. One of the primary considerations in deciding the location of many of these new industries was the availability of low freight rates. However, the proximity of raw materials, ample labor supply, and other supporting industries were important factors governing their establishment. The revitalization of the coal mining industry in the vicinity of Birmingham and Tuscaloosa can be attributed largely to the increased use of coal as a fuel by the various steam powerplants along the waterway and at Mobile and Pensacola. The wide variety of industries which have developed has resulted in a large diversification of labor skills in the area, such

as those required in the production of iron and steel articles, chemicals, petroleum products, paper, and household appliances.

This industrial expansion in Alabama has opened fields for a great number of small industrial establishments which supply complementary services for the larger plants. The recreational features of the waterway have provided greater opportunities for small businesses such as marinas, sporting goods stores, and boatbuilders. The many industries, large and small, support a labor force with many and varied skills which provide the municipalities of the area with a stable self-supporting economy.

WATER IS WEALTH [1]

by

JAY J. KALEZ

Chief, Technical Liaison Branch, U.S. Army Engineer District, Walla Walla, Wash.

Land of sand, sage, and solitude. A generation back, the scatter of settlers along the barren Columbia-Snake River shoreline accepted that descriptive identity without a protest. The few, bold enough to expound the possibility of a future comprehensive river development program, earned only taunts and ridicule.

River resources development—multipurpose dam benefits—for whom? The rattlesnakes, the jackrabbits?

Water a nautral resource—for what? Toll bridge building—ferry-boat operation? An incentive to new industry—what industry? Sagebrush harvesting?

River development critics of a generation ago were brutal in their comments. Today, the fertile river regions of the Columbia and Snake are a spectacular rebuttal to these early doubters.

In the fall of 1953, the spillway gates at the U.S. Army Corps of Engineers' $285 million multipurpose McNary lock and dam project on the Columbia River above the Oregon shore town of Umatilla were closed for the first time. Behind the huge barrier of concrete there was quickly formed the 61-mile-long reservoir stretching upstream from the dam to the Pasco-Kennewick area. Within a few weeks that reservoir became officially christened Lake Wallula.

McNary Dam was the first post-World War II multipurpose project to be constructed on the Columbia River. Far upstream was the great Grand Coulee Dam whose tremendous hydroelectric power capability had already proven itself during the war years. Far downstream at tidewater elevation was the Corps of Engineers' first multipurpose effort, Bonneville lock and dam.

A third dam, Rock Island Dam on the Columbia River downstream from Wenatchee, was strictly a run-of-the-river hydroelectric power project.

McNary Dam was the first project to exploit fully all of its potential benefits: hydroelectric power, navigation, flood control, recreational facilities, irrigation potentialities, and improvement of fish and wildlife perpetuation.

With its official dedication in the fall of 1954 by President Dwight D. Eisenhower, McNary lock and dam was put into operation, a positive step in the Corps' program for full development of the water resources of the Columbia and Snake Rivers.

Interstate Highway 80 rims the south shore of the Columbia from below Wallula to Portland. To visitors and motorists, McNary's crowning forest of transmission towers and awninglike maze of high tension wires is as awesome as the simple-lined immensity of the dam itself.

McNary is easily accessible for a closeup view. From the visitor's balcony along its quarter-mile-long powerhouse, McNary's line of 14 generators pours out its million-kilowatt symphony of power to the rumbling roar of the river water through the turbine scroll cases. Few visitors leave this impressive scene without experiencing a tinge of pride for a generation's accomplishment.

Below McNary, the Umatilla-Plymouth Bridge across the Columbia makes a visit possible to both the Oregon and Washington shore installations. The Oregon shore accommodates the powerhouse and the Washington shore the McNary Dam navigation lock. This 86-foot-wide by 675-foot-long lock is capable of lifting or lowering the tandem tows of cargo barges the 100 feet from the downstream river level to the reservoir elevation behind the dam.

---

[1] Reprint of article published in the June 1963 issue of *Cascades* by Pacific Northwest Bell Telephone Co.

It was McNary's elimination of the treacherous river rapids that provided the stimulus for the first impact of shoreline industrial growth.

Today, McNary lock clearance tonnage averages 100,000 tons a month in barge traffic. Upstream cargoes consist of commodities such as bulk cement, anhydrous ammonia, bulk molasses, and all types of petroleum products from gasoline to diesel and stove oil. Downstream tonnage consists mostly of grain—wheat, barley, and rye, moving by barges downstream from McNary Reservoir port elevators and consigned to tidewater elevators at Portland, Oreg., and Vancouver, Wash.

Since McNary's dedication, The Dalles Dam above The Dalles, Oreg., has been completed. With its 30-mile-long reservoir, it eliminates the time-delaying Celilo Falls channel passage. The John Day lock and dam project, now well past its halfway construction mark, will soon add further navigation inducement by eliminating the 70-mile-long fastwater stretch between the headwaters of The Dalles pool and the McNary downstream navigation gate.

The Corps of Engineers' plan for future navigation development on the Snake augments the Columbia's barge traffic incentive. On the Snake River four dams are in various stages of completion.

Nine and seven-tenths miles above the confluence of the Snake and Columbia is Ice Harbor lock and dam, completed and dedicated May 1962. Thirty-two miles upstream above Ice Harbor is Lower Monumental lock and dam, now well along in its first construction step. Above Monumental is Little Goose lock and dam whose construction started last April. Thirty-seven miles above Little Goose is Lower Granite lock and dam, now in full planning stage. Its elevation will bring slack water from Lewiston and Clarkston to Astoria.

At all four of the completed dams—Bonneville, The Dalles, McNary and Ice Harbor—visitor facilities include accessibility to the huge fish ladders. At each project these huge concrete channels with their series of steplike pools make possible the passage of migrating salmon and steelhead.

Counting stations at each ladder head provide an accurate tally of anadromous fish traveling the passageway. To both fishermen and fish, the Columbia River is a steelhead paradise. Huge highway signboards boast that fact. At the ladder heads visitors may, during the running season, see the mammoth chinooks and flashing steelheads move across the ladder's counting board.

Over $150, million is being expended by the U.S. Corps of Engineers in the relocation of railroads, highways, and even entire communities that will become inundated by the John Day backwater. Towns such as Arlington, Blalock, Boardman, and Umatilla on the Oregon shore and Roosevelt and Plymouth on the opposite Washington shore are all being reborn on higher ground above the inundation line. All this relocation must be carried on without interruption of traffic on either of the two mainline railroads or to motor traffic utilizing the shoreline highways.

But it is above McNary that the potential effect of multipurpose dam benefits becomes obvious. Obvious as well is the evidence that no one phase of water resource benefits is responsible for the area's phenomenal progress economically, industrially, and in transportation.

Hydroelectric power has promoted a shoreline of new industrial developments. So, too, has slack-water navigation, eliminating hazardous river stretches. Inviting recreational facilities are accessible at every highway turnout. No region displays the effect of newly created recreational facilities as does the Columbia River and its 60-mile-long Lake Wallula. Parks, marinas, boat launching ramps, fishing and picnicking sites, all easily accessible by paved highways, dot the river shore.

Kennewick's Columbia Park, with its protective boat haven at Clover Island, is a shoreline attraction for all tourists. Downstream at the mouth of the Snake is beautiful Sacajawea Park, whose name honors the Indian girl famous for her trek westward with the Lewis and Clark Expedition. Just across from Sacajawea on the Walla Walla County side of the Snake River is Hood Park, a new development just beginning to materialize.

On the Snake River, many parks and recreational sites are being planned. Each reservoir above Ice Harbor will have its allotment of fully developed public parks. Stretched below Hood Park is the McNary National Wildlife Game Refuge where geese, ducks, and pheasants by the thousands feed.

On further downstream is the Burbank Slough, with its public hunting and fishing area. Further downstream is the Wallula State Park on the Walla Walla River. Here small craft moorage, boat havens, fishing, and boat launching facilities are available. Downstream on the Columbia, in Oregon, is Hat Rock Park, one of the most patronized recreational spots on the river. No outing at Hat Rock is complete without a visit to McNary Dam and its vista points.

The raised water table due to the lifted reservoir level encourages small acreage farms. Irrigation by modern methods becomes exceptionally low in cost. Cattle raising and feed-lot operations are proving profitable on both a large and small scale.

But it is the combination of all these benefits: agriculture, navigation, hydroelectric power, industry and recreation, that over the past decade has stimulated forward progress within this vast inland river empire. Every river community reflects the boom of expansion. Pasco's slogan, "Watch Pasco Grow," has suddenly materialized. Kennewick, just across the river, with its compact business area, is now the home address of a colony of new chemical plants. Richland, the once government-owned atomic energy town, is now a big part of the Tricity combine. Umatilla is certain to enjoy profitable navigation benefits with the development of its port of Umatilla on the John Day pool. These thriving communities are evidence of the benefits multipurpose dams have brought to the region—all within a decade.

There has been a constant increase in river port authorities. Among these are Port Kelley, the ever-expanding Boise Cascade Pulp and Kraft Paper Plant within the port of Walla Walla site, and Burbank with its new 4-million-bushel grain storage facilities including rail and barge accommodations.

Every potential river site seems to reflect the mood of progress. Ice Harbor, with its lock in operation only 2 months, is already earning recognition to its grain passage potentiality from the wheatlands along the Lower Snake. With the four dams now assured on the Lower Snake, slack water navigation from Pacific Ocean tidewater to the very heart of the Inland Empire wheat-growing regions is a certainty within the coming decade.

The shoreline transformations that have occurred along the McNary Reservoir will, with reasonable certainty, repeat themselves along the reservoirs of the Snake River projects. The line of railroad tankcars at petroleum and chemical plants below Kennewick, along with a steady stream of motortrucks moving in and out of port sites, prove all types of transportation are stimulated by these river shore developments.

New industries encourage the tapping of new resources, create new opportunities, attract new people. Utilization of the vast water storage potentialities of the Columbia-Snake drainage area has barely begun, its resource potentiality barely realized.

Today, water means wealth.

Chapter I

A PROGRAM FOR WATER RESOURCE DEVELOPMENT

1. SCOPE

The water resource development program of the Corps of Engineers constitutes a major portion of the Federal plan for conserving, developing, and using the Nation's water resources, for navigation, flood control, hydropower, water supply, water quality control, recreation, fish and wildlife preservation, shore protection, and related purposes. The program, with a current expenditure level of over a billion dollars a year, covers all 50 States, the District of Columbia, and possessions.

Navigation improvements at both coastal and Great Lakes harbors and channels generally involve the dredging of channels and anchorages and the protection of entrances and anchorages by jetties and breakwaters. Rivers are improved for navigation by dredging, regulating works, and canalization by locks and dams. Flood control is accomplished by increasing the carrying capacity of stream channels, by diversion channels, by reservoir storage of floodwaters, and by levees and floodwalls.

The program naturally affords possibilities for conservation and use of water resources. Reservoir projects often develop hydroelectric power; store water for industrial, municipal, and agricultural use; and improve the quantity and quality of low water flows. In many cases, projects furnish large public recreational values, and preserve and enhance fish and wildlife resources. Congress has specified the areas to be investigated, prescribed the policies to be followed, and defined the limits of Federal participation.

2. STATUS

Federal activity in providing navigation improvements dates back to the River and Harbor Act passed in 1824. The major growth of the water resources program has come since 1928, when Congress adopted the project for the alluvial valley of the Mississippi, and particularly, since 1936, when Federal participation in flood control on a nationwide basis was first authorized.

3. ORGANIZATION

The Civil Works mission is accomplished through a decentralized organization comprising 11 divisions which are subdivided into 38 districts completely covering the United States and its oversea possessions. To the extent practicable, division and district boundaries are determined on the basis of logical groupings of river basins, subbasins, or coastal areas.

About 100 Corps of Engineers officers and 29,000 civilian employees, exclusive of contractors' personnel, are assigned to Civil Works activities.

CHAPTER II

BENEFITS

Since 1824, the Corps of Engineers has built and maintained most of the Nation's harbors and navigable waterways. Since 1936, when the Federal Government assumed responsibility for nationwide flood control, the Corps has been assigned the major responsibility for carrying out that task. The active program, including the $1.8 billion Mississippi River and tributaries project authorized in 1928, consists of about 3,600 project authorizations and/or projects authorized by law, having an estimated cost of $22 billion. Projects costing about $5 billion have been completed, and an additional $7 billion has been invested in projects under construction. Uncompleted portions of work underway, and authorized projects not started, aggregate about $10 billion. The water resources projects now in operation have reduced transportation costs and flood damages, and provided electric energy, improved water supplies, public recreation, and benefits from the preservation and enhancement of fish and wildlife resources.

1. NAVIGATION

The navigation element consists of three major parts: coastal harbors and channels; Great Lakes harbors and channels; and inland and intracoastal waterways. In calendar year 1962, the waterborne commerce of the United States amounted to 1,129 million tons, consisting of 534 million tons on coastal harbors and channels, 177 million tons on the Great Lakes, and 418 million tons on inland and intracoastal waterways. The total Great Lakes and inland and intracoastal waterways commerce amounted to 223 billion ton-miles, of which 90 billion moved on the Great Lakes and 133 billion on the inland and intracoastal system. Each of these three systems has, by savings in transportation costs, more than justified construction and operating costs. (An analysis of that program is contained in ch. III, vol. 1, of the 1955 Annual Report.)

Coastal harbors and channels. Natural harbors and channels are being progressively improved to provide the greater depths required for ocean carriers of today. Depths of 35 feet now generally prevail at major harbors on the Atlantic and gulf coasts, ranging up to 45 feet in New York Harbor. Depths of 30 to 40 feet are generally available along the Pacific coast. Harbors and channels of lesser

depth also have been provided for commercial fishing, recreational boating, and harbors of refuge.

Great Lakes harbors and channels. These vast water areas, joined by the connecting channels, provide a low-cost transport artery that permits movement of materials and products in huge quantities to advantageously located industrial areas. Controlling depths in the connecting channels are now 27 feet in both upbound and downbound channels. There are some 60 harbors on the Great Lakes with authorized project depths of 18 to 27 feet.

The Great Lakes are connected with the Gulf of Mexico by means of 9- to 12-foot barge navigation on the Illinois Waterway and Mississippi River. Connections with the Atlantic Ocean are provided by the New York State barge canal system and Hudson River, and by the 27-foot St. Lawrence Seaway.

Inland and intracoastal waterways. These waterways have proved their worth as routes for low-cost movement of bulk commodities to supplement the major forms of overland transport.

The Federal Government has improved in varying degree some 22,000 miles of inland waterways, of which about 19,000 miles are currently in commercial use. Commerce on the inland and intracoastal waterways increased about 8 percent during the past year, to establish a new record of 133 billion ton-miles.

2. FLOOD CONTROL

The first major Federal participation in flood control began in 1928, when Congress adopted the present project for flood control and navigation in the alluvial valley of the Mississippi. The responsibility for nationwide flood control was assigned to the Corps of Engineers by the 1936 Flood Control Act, which also established the Federal policy for that activity.

The authorized flood control program, including the $1.8 billion Mississippi River and tributaries project, is estimated to cost $6.9 billion. Since 1936, the Corps of Engineers has completed nearly 500 projects having a cost of about $1.6 billion. Projects having an estimated cost of $3 billion are under construction, and many of these have been advanced to the point where they are at least partially effective for flood control. The remainder of the active flood control program, estimated to cost $2.3 billion, has not been started Many multiple-purpose reservoir projects with power also provide important flood control benefits. As shown in appendix C, a total of almost 800 Corps of Engineers projects of all categories are now fully or partially effective for flood control.

Corps of Engineers projects have been highly effective in reducing flood damages. During the limited period they have been in opera-

tion, they have prevented flood damages of almost $12 billion. More than $525 million of flood damage was prevented during fiscal year 1963.

The Nation will remain vulnerable to severe flood damage from major floods until an adequate degree of protection is achieved. This goal may be reached through orderly prosecution of existing flood control plans, expanded to meet economic development taking place in flood plains. The results from operating flood-control projects prove that much of the flood damage now experienced can be economically prevented.

3. HYDROELECTRIC POWER

The position of hydroelectric power development in the program has grown with the increasing needs of the Nation for electric energy, and the expanding Federal interest in its development and use. The construction of reservoirs has afforded wide possibilities for the development of waterpower. Hydroelectric power production at Corps projects in operation during fiscal year 1963 amounted to 30 billion net kilowatt-hours of electric energy. This represents about 21.5 percent of the hydroelectric power production, and about 4 percent of the total electric production, from all public and private electrical generating plants in the Nation. Appendix D shows installed capacity and generation.

4. WATER SUPPLY

Domestic and industrial. The Corps of Engineers is presently operating about 1.6 million acre-feet of water supply storage space in 23 reservoirs, which supplements the water supplies for over 2 million people in 67 towns, cities, and rural areas. Storage in those reservoirs provides the main source for several communities and has been of great value particularly during drought periods. It is estimated that a dependable supply in excess of 1,200 million gallons per day is available from water supply storage space now in operation.

There is presently about 4 million acre-feet of water supply storage space under construction in 24 reservoir projects.

Low-flow regulation. Conservation releases and releases from hydropower generation improved the quantity and quality of downstream flows, benefiting water supplies, recreation, and fish and wildlife.

Irrigation. Almost 5 million acre-feet of storage is being operated either exclusively for irrigation, or jointly for that and other uses. An additional 145,000 acre-feet to be used exclusively for irrigation, and 735,000 acre-feet of joint-use storage, will be provided in four projects now under construction.

5. PUBLIC RECREATION USE

The Civil Works program contributes to the Nation's outdoor recreational opportunities through the development of water resource projects. The construction of reservoirs, harbors, and waterways, and the protection of coastal beach areas foster increasing recreational benefits. Public use visitation at reservoirs and certain waterway projects reported for calendar year 1962 increased to 127 million, a significant contrast to the 16 million annual attendance in 1950. Our expanding population with more leisure time, more purchasing power, and more mobility continues to seek more opportunities to enjoy the outdoors, and quickly takes advantage of the new artificial lakes created through the construction of reservoirs. This is evidenced by the peak-day attendance of 2,800,000 using the facilities and 170,500 watercraft in operation on these waters.

Recreational craft are also operating extensively on more than 20,000 miles of inland waterways that were once used primarily for commercial navigation. Over 250 small boat harbors have been developed with Federal assistance on the coasts, Great Lakes, and inland waterways.

Recreation has become so extensive a use of water resource projects that it can now be considered a factor in the economic justification for construction of multiple-purpose dams and reservoirs.

The basic recreation facilities such as access roads, parking areas, boat-launching ramps, water wells, and toilets are for the most part provided by the Federal Government. As a cooperative venture, many of the States, counties, cities, and communities fund and actively participate in both the construction and maintenance of public-use facilities at Corps of Engineers projects. Such facilities and the necessary services are also provided on a commercial basis by concessionaires who engage in the rental and care of boats and the provision of food and overnight accommodations. At some projects such facilities and services are developed and operated by governmental agencies. In addition, quasi-public agencies are authorized to develop certain project areas, and many boys' and girls' camps are sponsored by such agencies. Approximately 230 of these camps have been developed on Corps reservoirs having lands available for such use.

The following table indicates recreational facilities and use at Civil Works projects as reported for calendar year 1962:

Reservoir access areas	3, 690
Public launching lanes	3, 120
Picnic areas	1, 610
Swimming beaches	640
Camping spaces	20, 340
Guest rental units	3, 800
Organized camps	230
Watercraft, rental boats	17, 400
Pounds of sport fish caught	22, 836, 400

The most significant increase in attendance has been in connection with family camping. This activity is conducted on approximately 20,000 individual sites with a great variety of equipment, ranging from tents to travel trailers. The most popular activities engaged in by campers are picnicking, swimming, boating, and water skiing.

An outstanding public-use development is located on Lake Sidney Lanier, a reservoir impounded by the Buford Dam on the Chattahoochee River, Ga. Since the reservoir was placed in operation in October 1957, attendance has grown to 6,152,000 in calendar year 1962. Attendance at Allatoona Reservoir, some 40 miles distant, increased to 2,806,000. Present public-use facilities at Lake Sidney Lanier include about 40,800 acres of water area, 51 designated access areas, 33 public boat-launching lanes, 17 picnic areas, and a swimming beach. Over 3,800 watercraft were in use on the peak day. About 176,000 pounds of sport fish were caught during the year.

6. FISH AND WILDLIFE

Fish and wildlife conservation is an important part of the public-use benefits derived from water resource development, as indicated by the fact that some 10 percent of the 127 million visitors in 1962 participated in these activities. There has been a steady increase in fishing and hunting licenses in counties adjacent to such projects. Fish and waterfowl resources are enhanced by the water area of about 3.5 million acres created by the reservoirs. Game management on approximately 3 million acres of project land above normal water areas has in many instances compensated for loss of natural habitat by inundation. A catch of almost 23 million pounds of sport fish was reported.

CHAPTER III

PLANNING

1. POLICY AND PROCEDURES

The Corps of Engineers continued participation with other Federal agencies and with agencies of the various States in the development of national water resource policies. In addition, various policies and procedures in use by the Corps of Engineers were reviewed, improved, and modified. The more important of these activities are discussed in the following paragraphs.

The Interagency Committee on Water Resources is composed of policy officials at the secretarial level of the Departments of Agriculture; Army; Commerce; Health, Education, and Welfare; Interior; and Labor; and the Federal Power Commission. The Committee establishes means and procedures to promote coordination of the water and related land resources activities of the member agencies, undertakes resolution of interagency differences, suggests to the President changes in policy that would promote coordination and reduce differences, and reviews problems referred to it by field committees. Field committees have been set up for the Missouri, Columbia, Pacific Southwest, and Arkansas-White-Red Basins, and the New England area. The Committee performs its regular activities principally through its subcommittees on hydrology, sedimentation, and evaluation standards.

Water quality control. Section 2 of the Federal Water Pollution Control Act amendments of 1961 (Public Law 87–88 approved July 20, 1961) provides for the inclusion of storage in reservoirs for the regulation of streamflow for water quality control, except that any such storage and water release may not be provided as a substitute for adequate treatment or other methods of controlling waste at the source. Under this legislation, consideration is given to the inclusion of water quality control storage in reservoir projects being surveyed or planned. The act also requires that the advice and review of the Secretary, Department of Health, Education, and Welfare, be obtained concerning this subject. An engineer manual has been prepared, in coordination with the Public Health Service, covering the policies and procedures to be followed.

Policies, standards, and procedures. On May 15, 1962, the President approved the "Policies, Standards, and Procedures in the Formula-

tion, Evaluation, and Review of Plans for Use in Development of Water and Related Land Resources" (printed as S. Doc. 97, 87th Cong., 2d sess.), as recommended by the Secretaries of the Army; Agriculture; the Interior; and Health, Education, and Welfare. On the same date, the Bureau of the Budget rescinded Budget Circular A–47. Concurrently with his approval of the standards, the President requested the four Secretaries to consider updating the policies and procedures on cost allocations, cost sharing, and other subjects of mutual concern. A working draft of a paper on evaluation of recreation and fish and wildlife benefits was drafted and circulated to participating agencies for consideration during the year. Field offices of the Corps have been furnished the new evaluation standards and have been instructed to apply the principles involved in current planning. Additional guidance was provided during the year, and complete revision of the engineer manuals and regulations on project planning in accordance with the standards was instituted.

The Omnibus Authorization Act of 1962. The River and Harbor and Flood Control Act of 1962 (Public Law 87–874, approved October 23, 1962) extended the Federal interest in participation in shore restoration and protection and in recreational improvements. Section 103 increased the Federal share for proposed economically justified shore protection works for publicly owned or used frontage from 33⅓ to 50 percent of construction costs, and permits Federal assumption of such costs up to 70 percent where the projects will protect State or other non-Federal public parks and seashore conservation areas. The increased limits were also applicable to authorized projects which were not substantially completed as of October 23, 1962. In addition, section 103 provided authority for the Secretary of the Army to reimburse local interests for the Federal share of work done by them on projects not exceeding $1 million in total costs, after initiation of survey studies forming the basis therefor, subject to certain provisions. It also provided the Secretary with authority to authorize and construct small shore and beach protection projects not specifically authorized by Congress, the Federal allotment for which shall not exceed $400,000 each. Section 110 authorized surveys of the coastal areas of the United States and its possessions, including the shores of the Great Lakes, in the interest of beach erosion control, hurricane protection, and related purposes, provided that surveys of particular areas shall be authorized by appropriate resolutions of either the Senate or House Committees on Public Works. This authority thus discontinued the previous basis for local applications for and cost sharing in cooperative studies. Section 207 amended section 4 of the Flood Control Act of 1944, as amended, and extended the Federal

interest in providing basic recreational facilities to all water resource developments under the control of the Corps of Engineers.

Aquatic plant control. Field operations have been continued on the pilot project for progressive control and eradication of noxious aquatic plants in the South Atlantic and Gulf Coast States. Techniques have been improved by research carried out with cooperating Federal and State agencies. The aquatic plant control project was modified by section 104 of the River and Harbor Act of 1962 to provide that research costs and planning costs prior to construction shall be borne fully by the United States and shall not be included in the cost to be shared by local interests.

Remedial works (relocations). Section 208 of the Flood Control Act of 1962 (Public Law 87–874 approved October 23, 1962) amended section 207 of the Flood Control Act of 1960 (74 Stat. 501). The amendment provides for constructing substitute roads to higher standards than the existing road, based on the traffic at the time of the taking. The cost of any additional betterment must be assumed by the responsible State or local governmental agency.

2. INTERNATIONAL BOUNDARY WATERS

International boundary water studies, United States and Canada. Pursuant to the treaty of 1909 between the United States and Great Britain relating to boundary waters between the United States and Canada, the International Joint Commission was organized in 1911. In general, the Commission exercises jurisdiction over matters involving the use, obstruction, or diversion of boundary waters. When such matters are assigned by the respective governments to the Commission for investigation and/or resolution, they are generally designated as "References." The Commission is empowered to utilize the services of Government agencies in both countries in carrying out the terms of such references. The Corps of Engineers has continued participation as a member of the following boards established by the Commission.

International Columbia River Engineering Board. This Board was established in April 1944 to investigate and report on the possibilities of cooperative water resource development by Canada and the United States. The Board's report was submitted to the Commission in March 1959 and subsequently served, in part, as a basis for negotiations culminating in a treaty between the United States and Canada, signed at Washington on January 17, 1961. The treaty was ratified by the U.S. Senate on March 16, 1961. Similar action by the Canadian Parliament is pending.

International Pembina River Engineering Board. This Board was appointed in June 1962 following the receipt of a reference, dated

April 3, 1962, from the two governments, to investigate and report upon what measures could be taken to develop the water resources of the Pembina River in North Dakota and Manitoba. The members appointed to the board formerly served in a similar capacity on the International Souris-Red Rivers Engineering Board.

International Passamaquoddy Engineering Board. This Board was one of two boards appointed in 1956 to investigate the feasibility of developing tidal power at Passamaquoddy, Maine, and New Brunswick. The Board submitted its report to the Commission in October 1959, and the Commission transmitted its report to the two governments in April 1961. The Commission's report is awaiting further action by the Governments of Canada and the United States.

International St. Croix River Engineering Board. This Board was appointed in September 1955 to determine whether further development of the water resources of the St. Croix River would be practicable and in the public interest. Subsequent to submission of the Board's report in September 1957, the Commission transmitted its report to the two governments on October 7, 1959. During the interim, and at the request of the Commission, the Board has been conducting field surveys to determine the degree and extent of pollution in the river.

International Saint John River Engineering Board. This Board was appointed in October 1950 to determine whether the waters of the Saint John River system, above tidewater near Fredericton, New Brunswick, could be more beneficially conserved and regulated. The Board's report was submitted to the Commission in April 1953. It outlined several projects, the development of which would be practical and in the public interest. The Commission submitted its interim report to the two governments in April 1954. Since that date the services of the Board have been retained to advise the Commission on any significant water resource developments that have taken place in the basin.

International Champlain Waterway Board. This Board was appointed in October 1962 following the receipt of a reference, dated July 5, 1962, from the two governments, to examine and report on the feasability and economic advantages of improving or developing a waterway from the St. Lawrence River in Canada through Lake Champlain to the Hudson River at Albany in the United States.

(*Note.* Boards of Control established by the International Joint Commission, their composition and duties, are described in volume 2 under "Miscellaneous Civil Works, International Boundary Waters.")

International Boundary and Water Commission, United States and Mexico. This Commission was established pursuant to the Water Treaty of 1944 with Mexico, which deals with the utilization of waters

of the Colorado and Tijuana Rivers and the Rio Grande. Falcon Dam on the Rio Grande, 130 miles upstream from Brownsville, Tex., was the lowermost and first to be built (completed in 1953) of the international storage dams provided for by the water treaty. The authorized Amistad Dam (formerly known as Diablo Dam), on the Rio Grande, is located 290 river-miles upstream from Falcon Dam. At the request of the Commission, certain design work on the Amistad project is underway by the U.S. Army Engineer Division, Southwestern, Dallas, Tex.

3. PROJECT DEVELOPMENT

Civil Works projects are authorized by Congress in accordance with the recommendations of the Chief of Engineers as set forth in survey reports. These investigations are authorized by acts of Congress and by resolutions of the Committees on Public Works. Many of the investigations made by the Corps of Engineers recommend authorization of individual river and harbor and flood control projects, while others contain recommendations for the comprehensive development of river basins.

At the beginning of the fiscal year, about 1,000 investigations were outstanding in the field offices of the Corps of Engineers. A number of these reports were completed in fiscal year 1963, while substantial progress was made on others.

During the year, the Public Works Committees of Congress adopted 107 resolutions requesting review of previous reports on proposed river and harbor and flood control improvements.

In addition, the River and Harbor and Flood Control Act, approved October 23, 1962, contains authorizations for surveys of 25 locations and 11 special reports.

The status of reports processed during fiscal year 1963 is summarized in the following table:

Reports transmitted to—	Number
Congress	167
Bureau of the Budget	125
State and Federal agencies	55
Reports received in OCE from field offices [1]	108
Total actions	455

[1] The reports submitted to OCE were simultaneously referred by the reporting officers to the Board of Engineers for Rivers and Harbors and/or the Beach Erosion Board for action.

4. BOARD OF ENGINEERS FOR RIVERS AND HARBORS

The Board held three meetings of 1 to 3 days' duration. The Board considered 63 reports, acting favorably on 22, unfavorably on 34, deferred action on 3, and returned 4 to the reporting officers for further consideration. The Board recommended construction of projects estimated to cost $1,107 million, of which $951 million is the estimated cost to the United States, and $156 million the cost to local interests.

5. BEACH EROSION BOARD

The Beach Erosion Board completed action on five beach erosion studies in cooperation with local public agencies during the fiscal year. The River and Harbor and Flood Control Act of 1962, Public Law 87–874, abolished further beach erosion control studies on a cooperative basis and provided that studies for this purpose now be made as Federal surveys wholly at Federal expense. Since the date of approval of that law, October 23, 1962, 17 new beach erosion control studies have been authorized as Federal surveys by resolutions of the Public Works Committees of the House or Senate. In addition, one existing but unstarted cooperative study authorized prior to fiscal year 1963 has been reauthorized as a Federal survey.

LIST OF BEACH EROSION CONTROL
COOPERATIVE STUDIES COMPLETED AND FEDERAL SURVEYS APPROVED

Cooperative Studies Completed During Year

Atlantic City, N.J.
Broward County and Hillsboro Inlet, Fla.
Falmouth, Mass.
Haleiwa Beach, Oahu, Hawaii
Hunting Island, S.C.

Federal Surveys Approved During Year

California
Daly City
El Granada Beach
Pacifica

Delaware
Kitts Hummock to Fenwick Island (review)

Florida
Duval County
Jupiter Island
Mullet Key
Pinellas County (review)
St. Johns County

Georgia
Sea Island and St. Simons Island
Tybee Island (Savannah Beach)

Hawaii
Kapaa, Kauai
Kihei, Maui
Maryland
Worcester County
New York
Jones Inlet to East Rockaway Inlet
North Shore of Long Island (Suffolk County)
Ohio
Lake County Line to Ashtabula
Washington
Titlow Beach

During the year, 19 reports were reviewed for probable effects of navigation improvements on adjacent shorelines. In addition, navigation improvement was considered in the combined navigation-beach erosion control report on Broward County and Hillsboro Inlet, Fla., and five hurricane survey reports were reviewed.

Results of the research investigations conducted by the Board are made available to the using public in the form of publications. A total of 15 technical reports by Board staff members were published during the year or are currently in press, and 3 technical memoranda and an annual bulletin were issued.

During the year, 19 distinguished foreign visitors from 11 foreign countries toured the Board's research facilities and discussed various phases of shore protection or research in coastal engineering with the staff.

In keeping with the continuing expansion of the national oceanographic program, plans were prepared and budgetary requirements were established for enlarging the research and development program of the Beach Erosion Board to permit its fuller exploitation under the expanded oceanographic program.

Amendments to the existing laws governing the Federal role in beach erosion control enacted by Congress during fiscal year 1963 provide for significant enhancement of Federal responsibility in this field. Where the costs of preauthorization studies were formerly shared on a 50–50 basis between the Federal government and local interests, the amended law now provides for such studies wholly at Federal expense, which places them on a similar basis with survey studies of rivers and harbors and flood control problems. However, where studies on the cooperative basis were formerly approved by the Chief of Engineers under authority of the Secretary of the Army, the Federal survey studies must now be authorized by resolution of the Public Works Committee of either the U.S. Senate or House of Representatives. The amended law also authorized construction of small beach protection projects by the Secretary of the Army

without specific authorization by Congress, provided the Federal share of costs does not exceed $400,000 for each project and no more than $3 million is spent for this purpose in any one fiscal year. It is expected that this provision will effectively assist the Federal program for beach erosion control. Other provisions of the amendments increased the permissible Federal share of construction cost for regular beach erosion control projects from one-third to one-half, and provided further that Federal participation in the cost of projects for restoration and protection of State, county, and other publicly owned parks and conservation areas may be as high as 70 percent of the total cost, exclusive of land costs, when such areas, at the discretion of the Chief of Engineers: (*a*) Include a zone which excludes permanent human habitation; (*b*) include but are not limited to recreational beaches; (*c*) satisfy adequate criteria for conservation and development of the natural resources of the environment; (*d*) extend landward a sufficient distance to include, where appropriate, protective dunes, bluffs, or other natural features which serve to protect the uplands from damage; and; (*e*) provide essentially full park facilities for appropriate public use.

The revised cost-sharing provisions under the new amendments were made applicable to existing authorized projects not substantially completed as of the date of approval of those amendments, and the Chief of Engineers, (utilizing the Beach Erosion Board), was directed to recompute the amounts of Federal participation in the costs of those projects accordingly. Recomputations have been made and approved for 55 uncompleted authorized projects which resulted in an increase in the total Federal share from $58,268,900 on the former basis to $77,978,400 under revised cost-sharing provisions, or a net increase of $19,709,500, of which $13,907,400 is applicable to initial construction and $5,802,100 to periodic nourishment totaled over the authorized period of Federal participation. Of the 55 authorized projects for which the Federal share was recomputed, 21 were found to qualify, all or in part, for 70 percent Federal participation as park and conservation areas.

6. ADVANCE ENGINEERING AND DESIGN

A backlog of projects ready for initiation of construction is in preparation to allow inclusion as the national budgetary policy permits, at the same time assuring the development of a sound and well-balanced program consistent with the Nation's needs. This preparation includes firm cost estimates, construction schedules, and detail for coordination with local interests.

With $16,990,894 made available, together with funds carried over from prior years, planning was prosecuted on 171 projects, consisting

of 33 navigation, 130 flood control, and 8 multiple-purpose projects. Planning on 53 of these projects was advanced to the stage where construction could be readily initiated. Funds of $16,241,320, representing approximately 82 percent of the total available, were obligated.

7. COLLECTION AND STUDY OF BASIC DATA

The collection and studies of basic data are indispensable to the planning, design, and operation of river basin projects in development of the Nation's water resources. This item includes cooperative activities performed by other Federal agencies at the request of the Corps of Engineers. Funds are provided by the Corps for the basic programs of observing, compiling and publishing data on streamflow, rainfall, and fish and wildlife resources. A description of these activities is presented below.

a. Cooperative Programs with the U.S. Weather Bureau.

(1) The Hydroclimatic Network of recording rainfall gages was operated by the U.S. Weather Bureau at the request of the Corps. Funds of $529,000 were transferred to the Weather Bureau by the Corps of Engineers for continuation of the network in fiscal year 1963. A total of 2,738 stations (2,296 recording) were in operation on June 30, 1963. Data are published by the Weather Bureau in "Hourly Precipitation Data" and "Climatological Data," issued monthly by States.

(2) The Hydrometeorological Section of the Weather Bureau continued to review meteorological aspects of the Corps of Engineers storm study program and to develop modern techniques of estimating probable maximum precipitation for use in engineering design. Funds of $130,000 were made available to the Weather Bureau to finance this operation during fiscal year 1963. Accomplishments during the year included studies of meteorological criteria for the Yukon River drainage area above Rampart, Alaska, for the Northwest U.S. Pacific Coast drainage basins, and for the Hawaiian Islands; printing and distributing Hydrometeorological Report 37, "Meteorology of Hydrologically Critical Storms in California"; completion of and printing Weather Bureau Research Paper No. 44, "Three-Dimensional Windflow and Resulting Precipitation in a Northwestern California Storm"; estimates of probable maximum precipitation for four project areas; and other investigations.

(3) The River and Rainfall Reporting Networks, currently totaling 38 in number, were continued to provide timely reports of rainfall and river stages for flood forecasting and

operation of projects. Funds of $155,419 were transferred to the Weather Bureau in fiscal year 1963 for this program.

b. Cooperative Stream Gaging Program with the U.S. Geological Survey. The Geological Survey continued the cooperative stream gaging program as required by the Corps. Funds amounting to $2,108,457 were transferred to the Geological Survey for construction and operation of approximately 2,178 stations during fiscal year 1963. Data from these stations are published by the Geological Survey in annual Surface Water Records issued for each State

c. Corps of Engineers Streamflow and Rainfall Data. The Corps of Engineers independently operates certain rainfall and stream gaging stations for special purposes. Data from these stations are published by the Corps, the U.S. Geological Survey, the U.S. Weather Bureau, or are maintained in field office files. (See ch. III, sec. 8, Research and Development, *Hydrologic studies.*)

d. International Water Studies. In order to carry out U.S. obligations under international agreements, several divisions and districts of the Corps of Engineers having jurisdiction over areas bordering Canada participated in a number of engineering and control boards functioning under the International Joint Commission. Funds in the amount of $85,000, appropriated for this purpose in fiscal year 1963 were made available to respective Corps offices to continue this important function.

e. Studies by the U.S. Fish and Wildlife Service. Funds were made available to the Fish and Wildlife Service for continuation of study of the effects of Corps of Engineers projects upon fish and wildlife resources and for enhancement of these resources, in accordance with the Fish and Wildlife Coordination Act, Public Law 85–624. A total of $100,000 was transferred to the Fish and Wildlife Service from appropriations for "General Investigations of the Corps of Engineers." Data from these studies and recommendations by the Service are incorporated in survey reports of the Corps submitted to Congress.

f. Flood Plain Studies. In accordance with section 206 of Public Law 86–645, flood plain studies are made to provide data on the flood hazard for the use of States and local governments in planning and regulating the use of flood plain lands. Studies are accomplished upon the request of States or local governments when indorsed by State coordinating agencies. The first funds for this program became available in fiscal year 1962. During fiscal year 1963, 34 new studies were initiated.

8. RESEARCH AND DEVELOPMENT

A comprehensive review was conducted of the existing research activities relating to the civil functions and responsibilities of the

Corps to serve as a basis for development of a 5-year research program. Coordination of the civil research requirements with other elements of the Corps of Engineers and with other governmental agencies has been facilitated by the proposed fiscal year 1964–fiscal year 1968 program.

Elements of the civil research program include:

Aquatic plant control
Beach erosion development studies
Engineering studies
Fisheries engineering investigations
Hydrologic studies
Hydrometeorological studies
Nuclear explosives for civil construction
Plan formulation and evaluation studies

Total costs for fiscal year 1963 for civil research was approximately $3,036,000. Activities under each of these elements are described herein.

Aquatic plant control. As a part of the general aquatic plant control program in the southeastern United States and along the gulf coast, the Corps is engaged in studies leading to more effective means for combating the spread of water-hyacinth, alligatorweed, and other obnoxious growths in the watercourses. In cooperation with the Department of Agriculture, U.S. Fish and Wildlife Service, State agencies, and private industry, the Corps is conducting field experiments on the aquatic plant control problem, and financing research by two universities regarding chemical control methods. During 1963, work was continued in testing available chemicals with regard to their effect on aquatic plants, with followup tests on those showing a possibility of being suitable for aquatic plant control. Chemical controls producing good results in laboratory and small-scale tests were further tested under field conditions on a much broader scale. Even though some tests show good results in controlling alligatorweed, no conclusion can be drawn as to a positive control. The Agricultural Research Service of the Department of Agriculture has concluded its work in South America on a biological control for alligatorweed, and is preparing to introduce into the United States a beetle which is a specific parasite of this weed and which may serve as a natural check upon its growth.

Beach erosion development studies. These investigations deal with the development of methods for restoring and maintaining the ocean shores of the United States, including the Great Lakes, and are referred to under the Beach Erosion Board activities in chapter III.

Engineering studies. Under the program, work on 83 research projects was conducted during the fiscal year. Results contributed to

more reliable design criteria, improved planning and design methods, utilization of better construction materials, and more effective construction and maintenance procedures. Total program cost for fiscal year 1963 was $1,239,125, of which approximately 68 percent was expended by the U.S. Army Engineer Waterways Experiment Station, 7 percent by the Beach Erosion Board, and the remainder by division and district offices.

Four investigations were completed during fiscal year 1963:

CW 032—Cracking in Reinforced Flood Control Channels (Los Angeles District).

CW 154—Low-Flow Frequency Analyses (Tulsa District).

CW 624—Precast Slab Forms for Mass Concrete (Little Rock District).

CW 857—Emergency Closure Gate Downpull Tests (Portland District).

In addition to these 4 completed projects, 14 substudies under continuing research projects were completed during the year, and 19 technical research documents were published to provide significant results for interim use prior to final completion of the entire investigation project.

Fisheries engineering investigations. A program of fisheries engineering research initiated in 1951 has been continued to determine the most efficient and economical design for structures and facilities for upstream and downstream passage of anadromous fish at dams in the Columbia River basin. Current studies have been oriented primarily to problems in the passing of young fish moving downstream through turbines, and in collecting of fish at the upstream face of dams and guiding their movement into safe passageways.

Hydrologic studies. Under this program, field offices of the Corps of Engineers continued essential studies on storms, sedimentation, streamflow and rainfall data and general hydrologic problems. The results of these studies are utilized in optimum design, construction and operation of water control structures. Funds of $175,000 were appropriated for these hydrologic studies in fiscal year 1963.

Hydrometeorological studies. These activities, carried out by the Weather Bureau with funds made available by the Corps, are described under "Collection and Study of Basic Data." Approximately one-half of these funds are applied to the development and refinement of general theoretical concepts relating to maximum precipitation criteria used for planning and design purposes, and is considered to be a research function.

Nuclear explosives for civil construction. This research activity is described separately in chapter VI of this report.

Plan formulation and evaluation studies. Under a 3-year contract, commencing in July 1961 (requiring $78,000 annually), the Corps has been supporting the Harvard Water Program of research in improving and rationalizing the investigation, formulation, and evaluation of multipurpose projects and of complex basinwide or regional project systems. This program, employing such analytical techniques as mathematical programing, simulation, and other facets of operations research or systems analysis, and utilizing high-speed electronic computation, is aimed at tailoring these tools of modern decision-making methodology to Corps requirements in comprehensive planning for optimal development of water and related land resources. The research studies to date have demonstrated the feasibility of applying these newer tools and techniques to the testing and evaluation of many more combinations of alternative purposes, projects, and scales of development than hitherto has been practicable.

CHAPTER IV

CONSTRUCTION AND OPERATIONS

During fiscal year 1963 the Civil Works program of the Corps of Engineers, comprising navigation, flood control and multiple-purpose projects and various related activities, was diligently prosecuted. Progress in carrying out project construction and placing additional works in useful operation was notable. Construction was initiated on 56 new projects and on new features at 8 units of the Mississippi River flood control project Also, construction operations were carried out on 155 additional projects and at additional units of the Mississippi River project. Sixty-one other projects, in addition to features at 2 units of the Mississippi River flood control project and at 11 multiple-purpose projects, were placed in effective operation. Major structural rehabilitation was carried out during the year on 27 navigation projects and 1 flood control project Minor structural rehabilitation was conducted on 23 navigation projects and 5 flood control projects.

A summary of project construction and operations by classes follows.

1. NAVIGATION

The present program for rivers and harbors as specifically authorized by Congress includes projects located throughout the United States, Puerto Rico, and the Virgin Islands. These projects are of various types: deep-draft harbors accommodating oceangoing vessels, shallow-draft channels for general small-boat navigation, inland waterways for commercial barge navigation, and the Great Lakes harbors and connecting waterways.

Construction. During fiscal year 1963, active construction operations were carried out on 116 navigation projects, of which 41 were placed in useful operation, as shown in table 1.

In fiscal year 1963, work was initiated on 21 navigation projects as listed in table 2.

The 54 navigation projects having major construction activity underway at the close of the fiscal year, exclusive of the 21 new starts listed in table 2, are shown in table 3.

Maintenance. Maintenance and operation activities were conducted on navigation projects during the fiscal year at a cost of $103,133,758. In addition, costs of $4,760,480 were incurred on activities for the protection of navigation and surveys of northern and northwestern

lakes. In allocating the funds being provided for project maintenance, every effort consistent with budgetary requirements is made to maintain navigation projects adequately to serve the reasonable requirements of commerce and navigation.

Rehabilitation. During fiscal year 1963, advance engineering and design activities were conducted on 26 major rehabilitation navigation projects at a cost of $322,235. Major structural rehabilitation was carried out on 27 navigation projects at a cost of $12,140,517. Minor structural rehabilitation was actively prosecuted on 23 navigation projects at a cost of $1,863,056.

Table 1. Navigation Improvements Placed in Useful Operation During Fiscal Year 1963

Project	Fiscal year started	Date placed in useful operation	Nature of improvement
Apalachicola, Chattahoochee, and Flint Rivers, Ala., Fla., and Ga.	1959	Oct. 1962	Construction of Columbia lock and dam.
Ashland Harbor, Wis	1963	Nov. 1962	Dredging.
Ashtabula Harbor, Ohio	1962	June 1963	Do.
Barbours Cut, LaPorte, Tex	1962	Mar. 1963	Do.
Biloxi Harbor, Miss	1963	Aug. 1962	Do.
Bridgeport Harbor, Conn	1961	June 1963	Dredging and rock removal.
Charleston Harbor, S.C. (anchorage)	1962	Oct. 1962	Dredging.
Christiansted Harbor, V.I	1963	Apr. 1963	Do.
Cleveland Harbor, Ohio	1962	Nov. 1962	Do.
Connecticut River, Essex, Conn	1963	Jan. 1963	Do.
Dam No. 27, Mississippi River, Ill. and Mo.	1959	Nov. 1962	Construction of rock-fill dam.
Dillingham Harbor, Alaska	1961	July 1962	Dredging.
Douglas Harbor, Alaska	1962	Aug. 1962	Do.
East Boat Basin, Cape Cod Canal, Mass.	1963	Apr. 1963	Dredging-utilities relocations.
Everett Harbor and Snohomish River, Wash. (1960 mod.).	1962	---do------	Dredging.
Gulf Intracoastal Waterway-Colorado River Channel (9-foot), Tex.	1961	Nov. 1962	Do.
Homer Harbor, Alaska	1961	Sept. 1962	Do.
Kawaihae Harbor, Hawaii	1962	July 1962	Do.
Lake St. Clair, Mich	1961	---do------	Do.
Manasquan River, N.J	1962	June 1963	Do.

Table 1. Navigation Improvements Placed in Useful Operation During Fiscal Year 1963—Continued

Project	Fiscal year started	Date placed in useful operation	Nature of improvement
Marina Del Rey, Los Angeles, Calif.	1958	Aug. 1962	Dredging, breakwater and revetment.
Newark Bay, Hackensack and Passaic Rivers, N.J.	1963	Dec. 1962	Dredging.
New York Harbor, N.Y. (ocean to Bayside Channel).	1962	June 1963	Do.
New York and New Jersey Channels, N.Y. and N.J.	1960	Dec. 1962	Dredging and rock removal.
Panacea, Fla.	1962	Feb. 1963	Dredging.
Port Aransas-Corpus Christi Waterway (Jewel Fulton Canal).	1962	Mar. 1963	Do.
Port Aransas-Corpus Christi Waterway, Channel to Viola (36-foot).	1962	Oct. 1962	Do.
Port St. Joe Harbor, Fla. (St. Joseph Bay).	1959	July 1962	Do.
Red Wing Harbor, Minn.	1962	Sept. 1962	Dredging (industrial harbor).
Rye Harbor, N.H.	1963	Oct. 1962	Dredging.
Sacramento River Deep Water Ship Channel, Calif.	1950	June 1963	Construction and dredging (barge canal and lock).
Seldovia Harbor, Alaska (channel work).	1961	Dec. 1962	Dredging.
Seldovia Harbor, Alaska (small boat basin).	1962	---do------	Do.
South Bristol Harbor, Maine	1963	June 1963	Do.
Straits of Mackinac, Mich.	1961	May 1963	Do.
St. Peters Creek, Md.	1962	Nov. 1962	Do.
Sunshine Skyway Channel, Fla.	1963	May 1963	Do.
Two Harbors, Minn.	1962	June 1963	Do.
Wanchese Harbor, N.C.	1963	Apr. 1963	Do.
Wethersfield Cove, Conn.	1963	Jan. 1963	Do.
Wrangell Narrows, Alaska	1963	May 1963	Do.

Table 2. Navigation Improvements Initiated During Fiscal Year 1963

Project	Date started	Scheduled fiscal year completion	Nature of improvement
Alma Harbor, Wis	June 1963	1964	Dredging.
Apalachicola River Channel improvement, Florida.	Aug. 1963	1966	Dredging and jetties.
Apponaug Cove, R.I	May 1963	1964	Dredging.
Bakers Haulover Inlet, Fla	June 1963	1964	Reconstruction—jetties and revetments.
Bayou Lafourche and Lafourche Jump Waterway, La.	Feb. 1963	1968	Dredging and construction.
Dam No. 4 reconstruction, Monongahela River, Pa.	June 1963	1966	Reconstruction of dam; lock modification.
Duluth-Superior Inner Harbor, Minn. and Wis.	Mar. 1963	1967	Dredging.
Flushing Bay and Creek, N.Y	Apr. 1963	1963	Do.
Fort Leavenworth Bridge, Missouri and Kansas.	Mar. 1963	1964	Remove abandoned structure.
Freshwater Bayou, La	Apr. 1963	1965	Dredging and construction.
Green Bay Harbor, Wis	June 1963	1964	Channel improvement.
Hammond Bay Harbor, Mich	July 1962	1964	Dredging.
Indiana Harbor, Ind	do	1964	Channel improvement.
Juneau Harbor, Alaska	do	1964	Dredging.
Kewaunee Harbor, Wis	June 1963	1964	Channel improvement.
Los Angeles-Long Beach Harbors (West Basin).	do	1964	Dredging.
Mississippi River, Baton Rouge to Gulf of Mexico, La. (1962 mod.).	do	1964	Do.
Mobile Harbor, Ala	do	1965	Do.
Pascagoula Harbor, Miss	Mar. 1963	1964	Do.
Portland Harbor, Maine	Apr. 1963	1966	Do.
St. Marks River, Fla	Jan. 1963	1964	Do.

Table 3. Navigation Improvements Under Construction Fiscal Year 1963

Project	Fiscal year started	Scheduled fiscal year completion	Nature of improvement
Aquatic plant control	1959	1966	Control and eradication of obnoxious aquatic plant growths.
Arkansas River and tributaries, Arkansas and Oklahoma.	1950	1970	Bank stabilization.
Baltimore Harbor and Channels, Md.	1961	1966	Dredging.
Barataria Bay Waterway, La.	1960	1964	Do.
Belleville locks and dam, Ohio River, Ohio and W. Va.	1962	1967	Replacement for existing locks and dams 18–20, inclusive.
Buffalo Harbor, N.Y. (1960 mod.)	1962	1964	Dredging.
Calcasieu River and Pass, La. (1960 mod.).	1962	1968	Do.
Calumet Harbor and River, Ill. and Ind. (1935 mod.).	1943	After 1968	Channel improvement.
Calumet-Sag modification, Illinois Waterway, Illinois and Indiana.	1956	1966	Do.
Cannelton locks and dam, Ohio River, Ind. and Ky.	1962	1968	Replacement for existing locks and dams 43–45, inclusive.
Captain Anthony Meldahl locks and dam, Ohio River, Ohio.	1958	1965	Replacement for existing locks and dams 31–34, inclusive.
Channel from Naples to Gordon Pass and Big Marco Pass, Fla. (12-foot).	1962	1964	Dredging.
Columbia River—Vancouver to The Dalles (Bingen Barge Channel).	1963	1964	Do.
Detroit River, Mich.	1957	1964	Do.
Detroit River, Mich. (Trenton Channel)	1962	1964	Do.
Duluth-Superior outer harbor, Minnesota and Wisconsin.	1962	1964	Do.
Everglades Harbor, Fla.	1962	1964	Do.
Great Lakes to Hudson River Waterway, N.Y.	1954	1966	Dredging, lowering sills on locks and guard gates, and raising bridges.
Gulf Intracoastal Waterway-Guadalupe River, Channel to Victoria.	1958	1965	Dredging and bridge construction.
Houston Ship Channel, Tex. (40-foot)	1961	1966	Dredging.
Hudson River, N.Y. (1954 mod.)	1960	1967	Dredging and rock removal.
Inland Waterway, Delaware River to Chesapeake Bay, Del. and Md. pt. II.	1962	1968	Dredging and bridge construction.

Table 3. Navigation Improvements Under Construction Fiscal Year 1963—Con.

Project	Fiscal year started	Scheduled fiscal year completion	Nature of improvement
Intracoastal Waterway, Caloosahatchee River to Anclote, Fla.	1960	1967	Dredging.
Intracoastal Waterway, Jacksonville to Miami, Fla.	1951	1964	Do.
Little Lake Harbor, Mich	1962	1964	Do.
Lorain Harbor, Ohio (1960 mod.)	1962	1967	Dredging, breakwater construction and bridge replacement.
Manistee Harbor, Mich	1962	1964	Dredging.
Markland locks and dam, Ohio River, Ind.	1956	1964	Replacement for existing locks and dams 35–39, inclusive.
Matagorda Ship Channel, Tex	1962	1965	Dredging and jetties.
Maxwell locks and dam, Monongahela River, Pa.	1961	1966	Replacement for existing locks and dams 5 and 6.
McAlpine locks and dam, Ohio River, Ky.	1957	1965	Reconstruction of locks and dam 41.
Mississippi River, Baton Rouge to Gulf of Mexico, La. (1945 mod.).	1960	1965	Dredging and construction.
Mississippi River between Ohio and Missouri Rivers.	1910	1968	Regulating works.
Mississippi River-Gulf outlet, Louisiana	1958	1966	Dredging and construction.
Missouri River-Kansas City to mouth	1912	1967	Bank stabilization.
Missouri River-Kansas City to Sioux City, Iowa (Sioux City, Iowa, to Rulo, Nebr.).	1928	1969	Do.
New Cumberland locks and dam, Ohio River, Ohio.	1955	1964	Replacement for existing locks and dams 7–9, inclusive.
New Poe lock, St. Marys River, Mich	1961	1968	Replacement of Poe lock.
Opekiska lock and dam, Monongahela River, W. Va.	1961	1966	Replacement for existing locks and dams 14 and 15.
Pike Island locks and dam, Ohio River, W. Va.	1959	1965	Replacement for existing locks and dams 10 and 11.
Port Allen lock and canal (Port Allen-Morgan City alternate route).	1955	1964	Construction and dredging.

Table 3. Navigation Improvements Under Construction Fiscal Year 1963—Con.

Project	Fiscal year started	Scheduled fiscal year completion	Nature of improvement
Port Everglades, Fla	1961	1965	Dredging.
Presque Isle Harbor, Mich	1961	1964	Do.
Rochester Harbor, N.Y. (1960 mod. stage I).	1962	1964	Do.
Sabine-Neches Waterway, Tex. (36-foot).	1957	1964	Do.
St. Anthony Falls, Mississippi River, Minn.	1949	1964	Lock and dam construction and dredging.
St. Clair River, Mich	1959	1967	Dredging.
St. Marys River, Mich	1958	1965	Do.
Saginaw River, Mich	1961	1965	Do.
Sandusky Harbor, Ohio (1960 mod.)	1962	1965	Do.
Santa Cruz Harbor, Calif	1962	1965	Dredging and jetties.
San Juan Harbor, P.R	1963	1964	Dredging.
Savannah River below Augusta, Ga	1959	1964	Dredging and construction.
Toledo Harbor, Ohio	1962	1964	Dredging.

2. SHORE PROTECTION

The policy of Federal assistance in the construction of works for the restoration and protection of shores against erosion by waves and currents applies to shores of the United States, its territories and possessions, that are owned by States, municipalities or other political subdivisions, and also to shores other than public if there is a benefit such as that arising from public use or from the protection of nearby public property or if the benefits to those shores are incidental to the project. The costs of restoration and protection of Federal property are borne fully by the Federal Government. Federal participation in the costs of a project for restoration and protection of State, county, and other publicly owned shore parks and conservation areas may be, at the discretion of the Chief of Engineers, not more than 70 percent of the total cost exclusive of land costs, when such areas:

(*a*) Include a zone which excludes permanent human habitation.

(*b*) Include but are not limited to recreational beaches.

(*c*) Satisfy adequate criteria for conservation and development of the natural resources of the environment.

(*d*) Extend landward a sufficient distance to include, where appropriate, protective dunes, bluffs or other natural features which serve to protect the uplands from damage.

(*e*) Provide essentially full park facilities for appropriate public use.

Federal participation in the costs of projects for other non-Federal publicly owned shores is limited to a maximum of one-half of the total cost. No Federal contribution toward maintenance is authorized, but under certain conditions, Federal contributions may be made toward periodic beach nourishment for a length of time specified by the Chief of Engineers in each case.

In addition to Federal participation in completed units of authorized projects, construction work by the Corps was continued at Oceanside, Calif., and on the coast of California, Carpinteria to Point Mugu (Ventura-Pierpont area). Work was also initiated at Imperial Beach and Cabrillo Beach, Calif.

3. FLOOD CONTROL (GENERAL)

Construction. During fiscal year 1963, active construction operations were carried out on 132 specifically authorized flood control projects, of which 20 were placed in useful operation, as shown in table 4.

During the year, excluding multiple-purpose projects, work was initiated on 26 specifically authorized flood control projects, as shown in table 5.

The 86 flood control projects under active construction during the fiscal year, exclusive of multiple-purpose projects and those projects placed in useful operation or initiated during the year as shown in tables 4 and 5, are listed in table 6.

Construction operations were also carried out pursuant to the small-project authority in section 205, 1948 Flood Control Act, as amended. Ten small projects were placed in useful operation pursuant to this program and 11 new projects were initiated during the year. In addition, design studies were carried out on 55 projects, and plans and specifications were under preparation for 19 projects which are expected to be initiated in fiscal year 1963.

Rehabilitation. During fiscal year 1963, major rehabilitation was carried out on one flood control reservoir project at a cost of $166,671. Minor rehabilitation was conducted on five projects at a cost of $395,300.

Maintenance. Maintenance and operation activities were conducted on 137 flood control projects during the fiscal year at a cost of $9,970,250. In addition, inspection of completed local flood protection works constructed by the Corps of Engineers but operated and maintained by local interests and scheduling of flood control operations for reservoirs of other Federal agencies cost $553,122.

Table 4. Flood Control Projects Placed in Useful Operation During Fiscal Year 1963

Project	Fiscal year started	Date placed in useful operation	Nature of project
Abiquiu, N. Mex	1956	Feb. 1963	Reservoir
Black Butte, Calif	1960	Nov. 1962	Do.
Brookville, Pa	1961	July 1962	Local protection
Drury Drainage District, Illinois	1961	June 1963	Do.
Fabius River Drainage District, Missouri.	1960	Oct. 1962	Do.
Hopkinton-Everett, N.H	1959	Dec. 1962	Reservoir
Lower Heart River, N. Dak	1958	June 1963	Local protection
Mad River, Conn	1961	Nov. 1962	Reservoir
Navarro Mills, Tex	1959	Mar. 1963	Do.
Nolin, Ky	1959	do	Do.
Oologah, Okla	1950	May 1963	Do.
Ottawa, Kans	1959	Dec. 1962	Local protection
Pawcatuck, Conn	1962	June 1963	Do.
Ridgway, Pa	1961	Oct. 1962	Do.
Santa Maria Valley levees, California.	1959	June 1963	Do.
Stewart Canyon Debris Basin and Channel, Calif.	1962	Jan. 1963	Do.
Two Rivers, N. Mex	1960	Nov. 1962	Reservoir
W. Kerr Scott Dam and Reservoir, N.C.	1960	Feb. 1963	Do.
Washington, Pa	1961	Oct. 1962	Local protection
Williamson, W. Va	1962	Jan. 1963	Do.

Table 5. Flood Control Projects Initiated During Fiscal Year 1963

Project	Date started	Scheduled fiscal year completion	Nature of project
Alamo, Ariz	Mar. 1963	1966	Reservoir.
Bear Creek, San Joaquin County, Calif.	June 1963	1965	Local protection.
Blue River, Oreg	May 1963	1969	Reservoir.
Butler, Pa	Mar. 1963	1965	Do.
Corbin, Ky	Jan. 1963	1964	Local protection.
Gering Valley, Nebr	Feb. 1963	1967	Do.
Gillham, Ark	May 1963	1968	Reservoir.
Hancock Brook, Conn	June 1963	1965	Do.
Huntington, Ind	do	1968	Do.
Iowa River-Flint Creek Levee District No. 16, Iowa.	July 1962	1967	Local protection.
New Bedford, Mass	Oct. 1962	1966	Do.
Northfield Brook, Conn	May 1963	1965	Reservoir.
North Fork of Pound, Va	Jan. 1963	1966	Do.
Paint Rock River, Ala	Aug. 1962	1965	Local protection.
Pine Creek, Okla	Jan. 1963	1967	Reservoir.
Sacramento River, bank protection, California.	June 1963	1974	Local protection.
Sacramento River, Chico Landing to Red Bluff, Calif.	do	1965	Do.
Sammamish River, Wash	Apr. 1963	1965	Do.
Shelbyville, Ill	May 1963	1969	Reservoir.
Socorro diversion channel, New Mexico.	Oct. 1962	1964	Local protection.
Subdistrict No. 1 of Drainage Union No. 1 and Bay Island Drainage and Levee District, No. 1, Illinois.	Feb. 1963	1967	Do.
Tucson diversion channel, Arizona	Apr. 1963	1966	Do.
Turtle Creek, Pa	Sept. 1962	1967	Reservoir.
Water quality study project, Red River Basin, Tex.	Feb. 1963	1965	Experimental construction.
West Branch, Ohio	July 1962	1966	Reservoir.
West Point, Nebr	June 1963	1964	Local protection.

Table 6. Flood Control Projects Under Construction During Fiscal Year 1963

Project	Fiscal year started	Scheduled fiscal year completion	Nature of project
Allegheny River, Pa. and N.Y.	1960	1966	Reservoir.
Alvin R. Bush (Kettle Creek), Pa.	1959	1964	Do.
Amite River and tributaries, Louisiana.	1957	1964	Local protection.
Barren River, Ky.	1960	1964	Reservoir.
Battle Creek, Mich.	1957	Indefinite	Local protection.
Beardstown, Ill.	1955	1964	Do.
Bethlehem, Pa.	1960	1964	Do.
Buffalo Bayou and tributaries, Texas.	1956	1969	Do.
Camanche, Calif.[1]	1962	1964	Reservoir.
Canyon, Tex.	1958	1965	Do.
Cape Girardeau, Mo.	1956	1964	Local protection.
Carlyle, Ill.	1958	1967	Reservoir.
Central and Southern Florida	1950	After 1969	Local protection.
Clear Creek Drainage and Levee District, Illinois.	1940	Indefinite	Do.
Cooper, Tex.	1958	Indefinite	Reservoir and channel improvement.
Cortland, N.Y.	1962	1964	Local protection.
Council Grove, Kans.	1961	1965	Reservoir.
Curwensville, Pa.	1962	1967	Do.
East Branch, Conn.	1962	1963	Do.
East Cape Girardeau and Clear Creek Drainage and Levee District, Illinois.	1940	Indefinite	Local protection.
East St. Louis and vicinity, Illinois	1937	1966	Do.
Elk City, Kans.	1962	1966	Reservoir.
Endicott, Johnson City, and Vestal, N.Y.	1957	1964	Local protection.
Evansville, Ind.	1939	Indefinite	Do.
Fall Creek, Oreg.	1962	1966	Reservoir.
Fishtrap, Ky.	1962	1968	Do.
Floyd River, Sioux City, Iowa	1961	1965	Local protection.
Fox Point, R.I.	1961	1966	Do.
Hanapepe River, Hawaii	1960	1964	Do.
Hunt Drainage District and Lima Lake Drainage District, Illinois.	1961	1968	Do.
Jackson Hole, Wyo.	1958	1964	Do.
John Redmond, Kans.	1960	1965	Reservoir.
John W. Flannagan, Va.	1960	1966	Do.
Kansas Citys, Kans. and Mo.	1940	Indefinite	Local protection.
Little Sioux River, Iowa	1956	1964	Do.
Littleville, Mass.	1962	1966	Reservoir.

See footnote at end of table.

Table 6. Flood Control Projects Under Construction During Fiscal Year 1963—Con.

Project	Fiscal year started	Scheduled fiscal year completion	Nature of project
Los Angeles County Drainage Area, California.	1935	1967	Local protection.
Lower Columbia River Basin bank protection works, Oregon and Washington.	1961	1972	Do.
Lower San Joaquin River, Calif	1957	1967	Levees and channels.
Manhattan, Kans	1961	1964	Local protection.
Marshall, Minn	1962	1964	Do.
Mason J. Niblack levee, Indiana	1962	1965	Do.
Middle Creek, Calif	1959	1967	Do.
Milford, Kans	1962	1966	Reservoir.
Millwood, Ark	1961	1966	Do.
Mississinewa, Ind	1962	1967	Do.
Mississippi River at Canton, Mo	1962	1964	Local protection.
Mississippi River at St. Paul, Minn	1961	1964	Do.
Missouri River agricultural levee, Sioux City to mouth.	1948	Indefinite	Do.
Monroe, Ind	1961	1965	Reservoir.
Muscatine Island Levee District and Muscatine-Louisa County Drainage District No. 13, Iowa.	1960	1966	Local protection.
New Hogan, Calif	1960	1964	Reservoir.
Oroville, Calif.[1]	1957	1968	Do.
Perry County Drainage and Levee Districts 1, 2, and 3, Missouri.	1937	1965	Local protection.
Pine Flat, Calif	1947	1965	Reservoir and channel improvement.
Pomme de Terre, Kans	1957	1964	Reservoir.
Pomona, Kans	1960	1964	Do.
Proctor, Tex	1960	1964	Do.
Red River below Denison Dam, levees and bank stabilization.	1948	1967	Local protection.
Red Rock, Iowa	1960	1968	Reservoir.
Rio Grande Floodway, N. Mex	1960	1963	Local protection.
Russian River Basin, Calif	1956	1964	Channel improvements.
Sacramento River flood control, California.	1918	1964	Local protection.
Sacramento River, major and minor tributaries, California.	1949	After 1965	Do.
St. Louis, Mo	1959	1967	Do.
Salamonie, Ind	1962	1966	Reservoir.
Salt Creek and tributaries, Nebraska.	1961	1966	Local protection.
San Antonio Channel improvement, Texas.	1957	1968	Do.

Table 6. Flood Control Projects Under Construction During Fiscal Year 1963—Con.

Project	Fiscal year started	Scheduled fiscal year completion	Nature of project
Shenango River, Pa. and Ohio	1961	1965	Reservoir.
Sheridan, Wyo	1962	1966	Local protection.
Sioux Falls, S. Dak	1956	1964	Do.
Sny Basin, Ill	1960	1966	Do.
Somerville, Tex	1962	1966	Reservoir.
Stillhouse Hollow, Tex	1962	1968	Do.
Success, Calif	1957	1964	Do.
Summersville, W. Va	1960	1965	Do.
Terminus, Calif	1958	After 1964	Do.
Texas City, Tex., hurricane-flood protection.	1962	1966	Local protection.
Topeka, Kans	1938	1966	Do.
Truckee River, Calif. and Nev	1960	1964	Do.
Tuttle Creek, Kans	1953	1964	Reservoir.
Vincennes, Ind	1952	Indefinite	Local protection.
Waco, Tex	1958	1965	Reservoir.
Willamette River Basin, Oreg	1938	1970	Local protection.
Wilson, Kans	1961	1966	Reservoir.
Wood River Drainage and Levee District, Illinois.	1947	1965	Local protection.

[1] Being constructed by local interests—Federal contribution for providing flood control storage.

4. MULTIPLE-PURPOSE PROJECTS INCLUDING POWER

The importance of multiple-purpose projects in relation to the overall activities of the Corps of Engineers continued to increase during the fiscal year as a result of the large construction program relating to these projects currently underway and the placing in operation of primary-purpose features at several projects. These projects have been designed to serve primarily in the interest of navigation or flood control and the production of hydroelectric power, although frequently other benefits, such as irrigation, pollution abatement, water supply, and recreation, are also realized.

The inclusion of power features in conjunction with other project features has often resulted in an enhancement of their economic value. Pertinent information on the power aspects of multiple-purpose projects is contained in a subsection below.

Construction. During the year, construction operations were carried out on 31 multiple-purpose projects, of which 11 projects had some or all primary features in useful operation at the end of the year. These projects are listed in tables 7 and 8.

During the year seven new multiple-purpose projects were started. These are included in table 9.

Of the multiple-purpose projects under active construction at the end of the fiscal year, 20 projects had no primary project features in operation. They are shown in table 9.

Operation and maintenance. Operation and maintenance activities were conducted on 40 multiple-purpose projects during the fiscal year at a cost of $23,194,979.

Hydroelectric power. The progressive increase in hydroelectric power generating capacity in multiple-purpose projects emphasizes the importance of power as a part of the expanding water resources development program of the Corps of Engineers civil works activities. Installed nameplate capacity in operation as of June 30, 1963, increased 9.4 percent over that in operation June 30, 1962. Electric energy production was 0.3 percent above the preceding fiscal year, although there were significant reductions in load factor in some areas.

Electric power produced at Corps of Engineers hydroelectric projects in excess of projects needs, must, under existing law and with the exception of one project, be delivered to the Department of the Interior for disposition at rates approved by the Federal Power Commission.

Installed capacity. During fiscal year 1963, eight generating units were placed in operation at two operating projects and two units were placed in operation at one new project for a total of 707,000 kilowatts (nameplate rating) of capacity as shown in table 10. This additional capacity represents 34.8 percent of the hydroelectric capacity and 12.4 percent of the total generating capacity added to the Nation's electric utility systems during the fiscal year.

On June 30, 1963, the Corps of Engineers had a total of 8,238,400 kilowatts of nameplate generating capacity in operation at 37 projects as listed in table 11. This represents 4 percent of the total generating capacity and 21.5 percent of the hydroelectric generating capacity in operation throughout the Nation at the end of the fiscal year.

Hydroelectric power production. During fiscal year 1963, 30 billion kilowatt-hours of electric energy was produced at Corps of Engineers multiple-purpose projects. This was an increase of 100 million kilo-

watt-hours, or 0.3 percent over the power production of the preceding fiscal year. Power produced at Corps of Engineers projects during the fiscal year was 3.4 percent of the total power produced in the Nation and 18.1 percent of the hydroelectric power produced. Chart I illustrates the trend of power produced for Corps of Engineers multiple-projects for the past 10 fiscal years.

Additional capacity under construction. As of June 30, 1963, the Corps of Engineers had under construction 155,000 kilowatts of generating capacity at 2 operating projects and 4,237,200 kilowatts of capacity at 21 new projects for a total of 4,392,200 kilowatts. The additional capacity is listed by projects in tables 11 and 12.

Projects in operation and under construction have an ultimate capacity of 17,451,600 kilowatts. Under construction schedules at the beginning of fiscal year 1964, 8,514,400 kilowatts of capacity should be in operation by June 30, 1964. Chart II shows the continuing increase in installed capacity at Corps of Engineers multiple-purpose projects for fiscal years 1958 through 1963 and scheduled additions for fiscal years 1964 and 1965.

Table 7. Multiple-Purpose Projects Completed for Full Beneficial Use During Fiscal Year 1963

Project	Fiscal year started	Scheduled fiscal year completion	Project primary purpose
Hartwell Reservoir, Savannah River, Ga. and S.C.	1956	1963	Flood control, navigation, and power.
Hills Creek Reservoir, Willamette River, Oreg.	1956	1963	Flood control, power, navigation, and irrigation.
Table Rock Reservoir, White River, Ark.	1953	1963	Flood control and power.

Table 8. Multiple-Purpose Projects Under Construction With Some or All Primary Project Features Placed in Useful Operation During Fiscal Year 1963

Project	Fiscal year started	Scheduled fiscal year completion	Features placed in operation during fiscal year 1963	Project primary purposes
Barkley Dam, Cumberland River, Ky. and Tenn.	1957	1967	----------	Navigation,* flood control, and power.
Fort Peck (2d powerplant), Missouri River, Mont.	1957	1964	----------	Power.*
Garrison Reservoir, Missouri River, N. Dak.	1946	1965	----------	Flood control* and power.*
Greers Ferry Reservoir, White River, Ark.	1957	1964	----------	Do.*
Ice Harbor lock and dam, Snake River, Wash.	1956	1964	----------	Navigation* and power.*
Oahe Reservoir, Missouri River, N. Dak. and S. Dak.	1949	1967	Generators 2–7, inclusive.	Flood control, navigation, power, and irrigation.
The Dalles Dam, Columbia River, Oreg. and Wash.	1952	1965	----------	Navigation, power, and irrigation.
Walter F. George lock and dam, Chattahoochee River, Ala. and Ga.	1956	1964	2–32, 500 kw units.	Navigation and power.

*Projects operated for these primary purposes at the beginning of and throughout fiscal year 1963.

Table 9. Multiple-Purpose Projects Under Construction and Not Operating During Fiscal Year 1963

Project	Fiscal year started	Scheduled fiscal year completion	Project primary purposes
Beaver Reservoir, White River, Ark.	1960	1966	Flood control, power, and water supply.
Big Bend Reservoir, Missouri River, S. Dak.	1959	1967	Flood control and power.
Broken Bow Reservoir, Mountain Fork River, Okla.	1962	1969	Do.
Bruces Eddy Reservoir, North Fork Clearwater River, Idaho.	1963	1972	Navigation and power.
Bull Shoals Reservoir (units 7 and 8), White River, Ark.	1961	1964	Power.

Table 9. Multiple-Purpose Projects Under Construction and Not Operating During Fiscal Year 1963—Continued

Project	Fiscal year started	Scheduled fiscal year completion	Project primary purposes
Carters Dam, Coosawattee River, Ga	1962	1967	Flood control and power.
Cordell Hull Dam, Cumberland River, Tenn.	1963	1970	Power, recreation and area redevelopment.
Cougar Reservoir, McKenzie River, Oreg.	1956	1965	Flood control, power, navigation, and irrigation.
Dardanelle lock and dam, Arkansas River, Ark.	1957	1968	Navigation and power.
DeGray Reservoir, Caddo River, Ark	1963	1970	Flood control, power and water supply.
Eufaula Reservoir, Canadian River, Okla.	1957	1965	Flood control and power.
Green Peter Reservoir, Middle Santiam River, Oreg.	1961	1968	Flood control, power, navigation, and irrigation.
J. Percy Priest Reservoir, Stones River, Tenn.	1963	1968	Flood control, power, and recreation.
John Day lock and dam, Columbia River, Oreg. and Wash.	1958	1970	Navigation and power.
Keystone Reservoir, Arkansas River, Okla.	1957	1968	Flood control and power.
Little Goose lock and dam, Snake River, Wash.	1963	1969	Navigation and power.
Lower Monumental lock and dam, Snake River, Wash.	1961	1969	Do.
McGee Bend Reservoir, Angelina River, Tex.	1957	1966	Flood control and power.
Millers Ferry lock and dam, Alabama River, Ala.	1963	1968	Navigation and power.
Stockton Reservoir, Sac River, Mo	1963	1969	Flood control and power.

Table 10. Generating Capacity Placed in Operation During Fiscal Year 1963

Projects	Size of units (kilowatts)	Number of units	Added capacity (kilowatts)
Hartwell	66, 000	2	132, 000
Oahe	85, 000	6	510, 000
Walter F. George [1]	32, 500	2	65, 000
Total		10	707, 000

[1] Initial operation of project.

Table 11. Hydroelectric Projects in Operation June 30, 1963

Projects	Initial operation in fiscal year	Nameplate capacity—kilowatts		
		Existing installation	Under construction	Ultimate construction
Albeni Falls, Idaho	1955	42, 600	----------	42, 600
Allatoona, Ga	1950	74, 000	----------	110, 000
Blakely Mountain, Ark	1956	75, 000	----------	75, 000
Bonneville, Oreg. and Wash	1938	518, 400	----------	518, 400
Buford, Ga	1957	86, 000	----------	86, 000
Bull Shoals, Ark. and Mo	1953	250, 000	90, 000	340, 000
Center Hill, Tenn	1951	135, 000	----------	135, 000
Cheatham, Tenn	1958	36, 000	----------	36, 000
Chief Joseph, Wash	1956	1, 024, 000	----------	1, 728, 000
Clark Hill, Ga. and S.C	1953	280, 000	----------	280, 000
Dale Hollow, Tenn	1949	54, 000	----------	54, 000
Denison, Okla. and Tex	1945	70, 000	----------	175, 000
Detroit, Oreg.	1954	118, 000	----------	118, 000
Fort Gibson, Okla	1953	45, 000	----------	67, 500
Fort Peck, Mont	1944	165, 000	----------	165, 000
Fort Randall, S. Dak	1954	320, 000	----------	320, 000
Garrison, N. Dak	1956	400, 000	----------	400, 000
Gavins Point, Nebr. and S. Dak	1957	100, 000	----------	100, 000
Hartwell, Ga. and S.C	1962	264, 000	----------	330, 000
Hills Creek, Oreg	1962	30, 000	----------	30, 000
Ice Harbor, Wash	1962	270, 000	----------	540, 000
Jim Woodruff, Fla. and Ga	1957	30, 000	----------	30, 000
John H. Kerr, N.C. and Va	1953	204, 000	----------	204, 000
Lookout Point, Oreg	1955	135, 000	----------	135, 000
McNary, Oreg. and Wash	1954	980, 000	----------	1, 400, 000
Narrows, Ark	1950	17, 000	----------	25, 500
Norfork, Ark. and Mo	1944	70, 000	----------	140, 000
Oahe, N. Dak. and S. Dak	1962	595, 000	----------	595, 000
Old Hickory, Tenn	1957	100, 000	----------	100, 000
Philpott, Va	1954	14, 000	----------	14, 000
St. Marys, Mich	1952	18, 400	----------	18, 400
Table Rock, Ark. and Mo	1959	200, 000	----------	200, 000
Tenkiller Ferry, Okla	1954	34, 000	----------	34, 000
The Dalles, Oreg. and Wash	1957	1, 119, 000	----------	1, 743, 000
Walter F. George, Ala. and Ga	1963	65, 000	65, 000	130, 000
Whitney, Tex	1954	30, 000	----------	30, 000
Wolf Creek, Ky	1952	270, 000	----------	270, 000
Total, projects in operation	------	8, 238, 400	155, 000	10, 719, 400

Table 12. Hydroelectric Projects Under Construction June 30, 1963 (No generating units in operation)

Projects	Scheduled for operation in fiscal year	Nameplate capacity—kilowatts		
		Existing installation	Under construction	Ultimate installation
Barkley, Ky. and Tenn	1965	----------	130, 000	130, 000
Beaver, Ark	1965	----------	112, 000	112, 000
Big Bend, S. Dak	1965	----------	468, 000	468, 000
Broken Bow, Okla	1968	----------	85, 000	85, 000
Bruces Eddy, Idaho	1972	----------	300, 000	300, 000
Carters, Ga	1968	----------	100, 000	100, 000
Cordell Hull, Tenn	1969	----------	100, 000	100, 000
Cougar, Oreg	1964	----------	25, 000	60, 000
Dardenelle, Ark	1965	----------	124, 000	124, 000
DeGray, Ark	1969	----------	66, 000	66, 000
Eufaula, Okla	1965	----------	90, 000	90, 000
Green Peter, Oreg	1967	----------	110, 000	110, 000
Greers Ferry, Ark	1964	----------	96, 000	96, 000
J. Percy Priest, Tenn	1968	----------	28, 000	28, 000
John Day, Oreg. and Wash	1967	----------	1, 350, 000	2, 700, 000
Keystone, Okla	1968	----------	70, 000	70, 000
Little Goose, Wash	1968	----------	405, 000	810, 000
Lower Monumental, Wash	1968	----------	405, 000	810, 000
McGee Bend, Tex	1965	----------	52, 000	52, 000
Millers Ferry, Ala	1968	----------	76, 000	76, 000
Stockton, Mo	1969	----------	45, 200	45, 200
Total, projects under construction		----------	4, 237, 200	6, 732, 200
Total, projects in operation (table 11)		8, 238, 400	155, 000	10, 719, 400
Total		8, 238, 400	4, 392, 200	17, 451, 600
Total, projects in operation and under construction		----------	12, 630, 600	----------

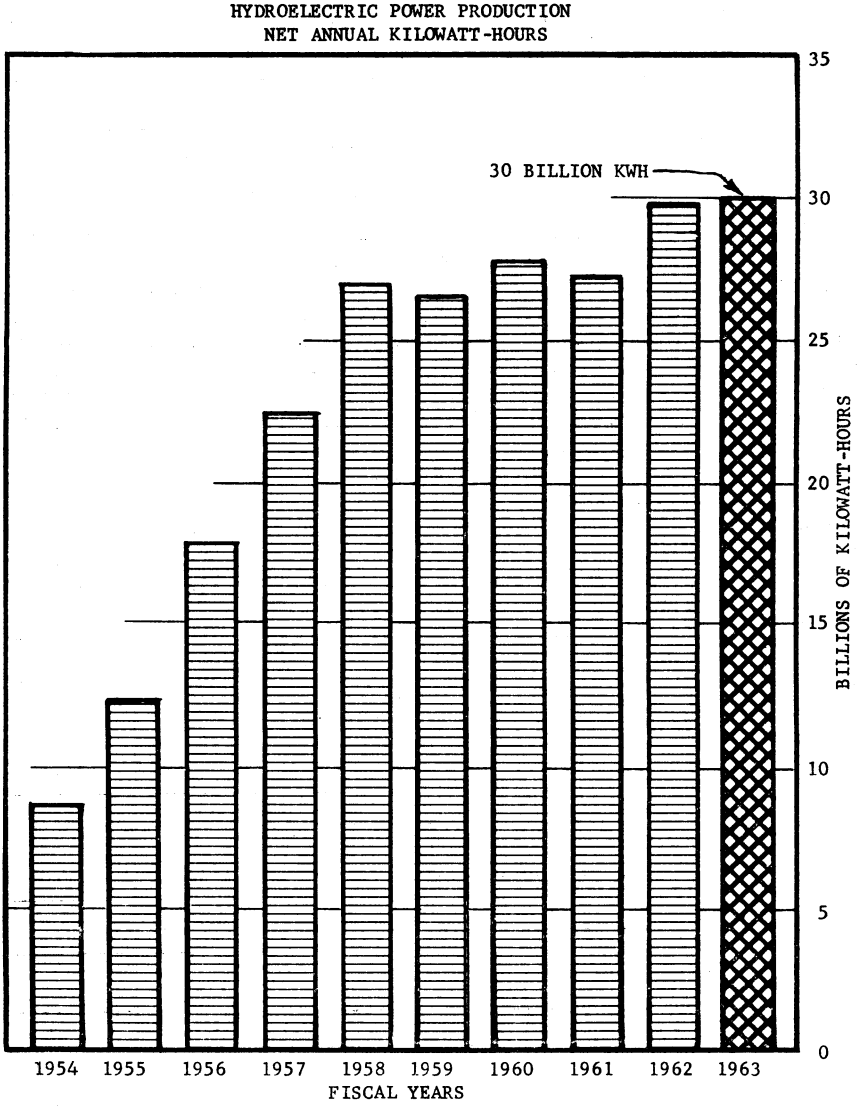
HYDROELECTRIC POWER PRODUCTION
NET ANNUAL KILOWATT-HOURS
30 BILLION KWH
35
30
25
20
15
10
5
0
BILLIONS OF KILOWATT-HOURS
1954
1955
1956
1957
1958
1959
1960
1961
1962
1963
FISCAL YEARS

CHART I

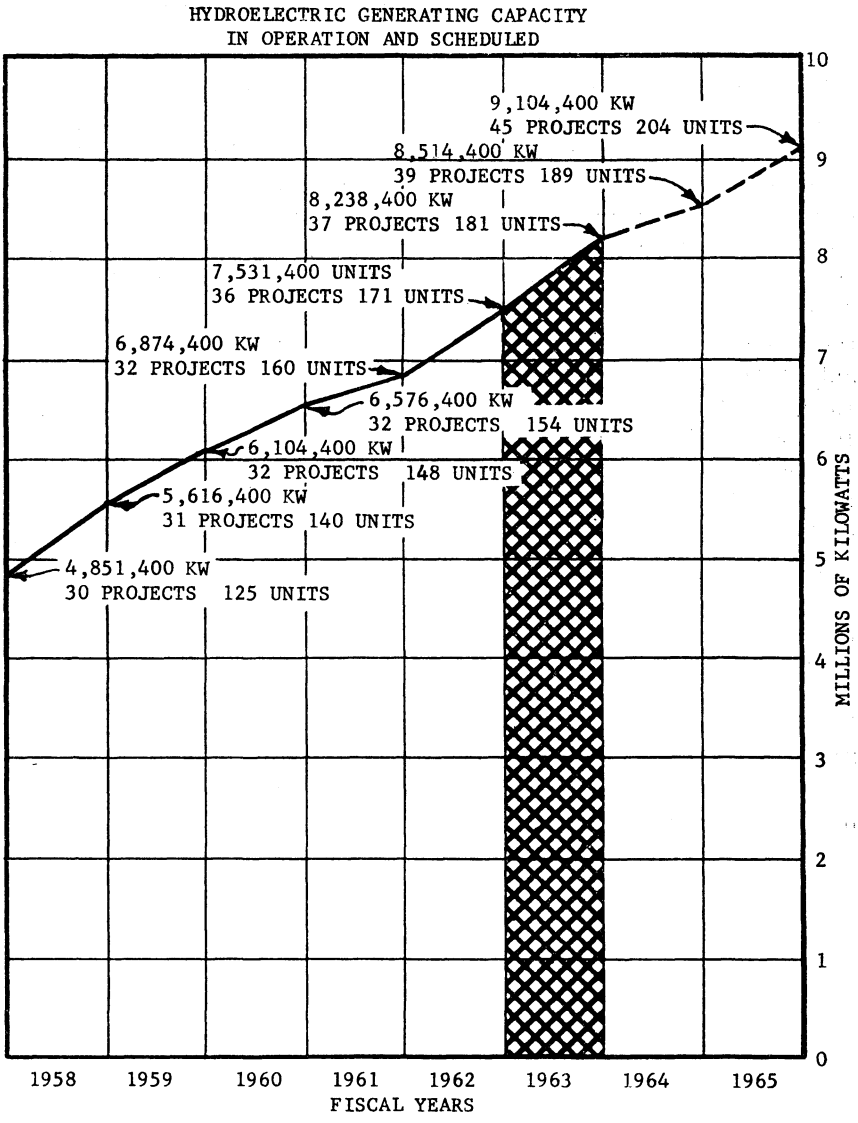
HYDROELECTRIC GENERATING CAPACITY
IN OPERATION AND SCHEDULED
9,104,400 KW
45 PROJECTS 204 UNITS
8,514,400 KW
39 PROJECTS 189 UNITS
8,238,400 KW
37 PROJECTS 181 UNITS
7,531,400 UNITS
36 PROJECTS 171 UNITS
6,874,400 KW
32 PROJECTS 160 UNITS
6,576,400 KW
32 PROJECTS 154 UNITS
6,104,400 KW
32 PROJECTS 148 UNITS
5,616,400 KW
31 PROJECTS 140 UNITS
4,851,400 KW
30 PROJECTS 125 UNITS
MILLIONS OF KILOWATTS
0
1
2
3
4
5
6
7
8
9
10
1958
1959
1960
1961
1962
1963
1964
1965
FISCAL YEARS

CHART II

5. FLOOD CONTROL, MISSISSIPPI RIVER AND TRIBUTARIES

Alluvial Valley

The project for Mississippi River and tributaries authorized by the Flood Control Act of May 15, 1928, and subsequent amendments provides for flood protection of its alluvial valley below Cape Girardeau, Mo., from Mississippi River and local floods by means of levees and floodwalls, channel realinement and stabilization, reservoirs, floodways and outlets and drainage works. Amendments through 1953 are described on pages 10 and 11 of part I, volume 1, of the Annual Report of the Chief of Engineers for 1953. Amendments to the project in the Flood Control Acts approved September 3, 1954, July 3, 1958, and July 14, 1960, are described in the reports of 1955, 1959, and 1961, respectively. The Flood Control Act of October 23, 1962, modified and expanded the project adopted by the Flood Control Act of May 15, 1928, to include improvements on Gin and Muddy Bayous, Yazoo Basin, Miss., at an estimated cost of $150,000; and authorized replacement of bridges over Boeuf River and Big Bayou, in Chicot County, Ark. The River and Harbor Act of October 23, 1962, modified the Devils Swamp (Baton Rouge Harbor), La., to provide suitable dikes or other retaining structures at an estimated Federal cost of $299,500.

The total authorization for the project at the end of the fiscal year is $1,449,441,600, of which $1,265,399,652 has been appropriated and $1,262,518,234 has been expended.

Construction. During the year, the following items of construction on eight features of the project have been completed:

Table 13. Project Features Which Have Been Fully Completed During Fiscal Year 1963

Project feature	Date completed	Nature of project feature
Greenville Harbor, Miss.	Apr. 1963	Harbor channel and port area fill.
Atchafalaya Basin, La.	Nov. 1962	North Bend Pumping Station.
Old River Control, La.	Feb. 1963	Navigation lock and approach channels.
Tensas Basin, La.	Apr. 1963	Bayou Macon channel improvement and related work for reaches 2, 3, and 4.
	Oct. 1962	Boeuf River (lower) channel improvement.
Tensas Basin, Ark.	Feb. 1963	Black Pond Slough channel improvement.
	Feb. 1963	State Highway 35 bridge and U.S. Highway 65 bridge over Black Pond Slough.
Yazoo Basin Headwater, Miss.	July 1962	West bank new levee, Belle Prairie to Wasp Lake, east bank new levee Yazoo City to Piney Creek, closure and drainage structure.
	June 1963	East bank new levee, Bee Lake to Belzoni.
	May 1963	East Bank Pompey Ditch levee setback (items 332–L and 335–L) Quitman and Tunica County bridge, Pompey Ditch.
	Oct. 1962	Humphreys Co. bridge and road relocation, Will M. Whittington Auxiliary Channel.
	Nov. 1962	Bobo Bayou, channel improvement, mile 0.0 to 1.21 (Little Tallahatchie River), mile 0.0 to 14.9. Three Panola County bridges, and road relocations, Bobo Bayou.
	Aug. 1962	McKinney Bayou pumping plant.
	Oct. 1962	Quiver River, channel improvement, mile 43.0 to 71.2.
	Sept. 1962	Bogue Phalia, channel improvement, mile 60.3 to 82.8.
	May 1963	Bogue Phalia, channel improvement, mile 0.0 to 8.5.
	Nov. 1962	Turkey Bayou, channel improvement, mile 0.0 to 5.6.
	Nov. 1962	Parks Bayou, channel improvement, mile 0.0 to 9.4.
	May 1963	Harris Bayou, channel improvement, mile 0.0 to 21.0.
Big Sunflower River	Mar. 1963	Channel improvement, mile 28.3 to 57.0 and mile 57.7 to 78.1.
Yazoo Basin Backwater, Miss.	Aug. 1962	New levee, items 2 and 3.
St. Francis Basin, Ark. and Mo.	Sept. 1962	Big Lake Floodway ditches.
	Dec. 1962	Round Pond drainage channel, St. Francis Bay enlargement.
	Mar. 1963	Wittsburg cutoffs.

During the year the following items of two features of the project were placed in useful operation.

Table 14. Project Features Placed in Useful Operation During Fiscal Year 1963

Project feature	Date started	Date placed in useful operation	Nature of project feature
Atchafalaya Basin, La			Pumping stations—interior drainage:
	Dec. 1961	Apr. 1963	Bayou Yokely.
	May 1962	Dec. 1962	North Bend.
Old River Control, La	Sept. 1959	Mar. 1963	Navigation lock.

During the year progress was made in the continuing construction of the principal features of the project on the main stem and on the tributaries in the alluvial valley. Main stem work on levees, revetments, dikes, and dredging was accomplished as follows: New mainline levees constructed, 2.6 miles; mainline levees enlarged to grade and section, 51.9 miles; secondary levees constructed, 47.1 miles; bank protection placed, 15.4 miles; dikes constructed, 12.8 miles; and construction dredging, 18,260,000 cubic yards. Work was continued on the following additional project features:

Table 15. Project Features on Which Construction Was Continued During Fiscal Year 1963

Project feature	Nature of project feature
Mississippi River	Levees, revetments, dikes, wavewash protection, and dredging.
Atchafalaya Basin, La	Levees, revetments, channel improvement by dredging, interior drainage and highway relocation.
Lake Pontchartrain, La	Levee enlargement, shaping, and wavewash protection.
Old River Control, La	Levees and bank protection.
Memphis Harbor, Tenn	Ensley levees.
Tensas Basin, La. and Ark	Channel improvements.
Yazoo Basin, Miss	Levees and channel improvement.
	State Highway 7 bridges (2), Greenwood protection works.
Big Sunflower River	Channel improvement, mile 99 to 169.5.
Arkansas River, Ark. (lower 40 miles).	Bank stabilization and levee berms.
Lower White River, Ark	White River backwater levee system, levee restoration.
St. Francis Basin, Ark. and Mo	Floodways, levees, interior drainage channels, highway and railroad crossings.

During the year work was initiated on the following project features:

Table 16. Project Features on Which Work Was Initiated During Fiscal Year 1963

Project feature	Date initiated	Nature of project feature
Atchafalaya Basin, La.	June 1963	Wax Lake West pumping station.
	June 1963	Gordy pumping station.
Old River Control, La.	Mar. 1963	Channel closure.
Tensas Basin, La.	Dec. 1962	Bayou Macon, channel improvement, reach 5.
	July 1962	Boeuf River (lower) channel improvement.
Tensas Basin, Ark.	Feb. 1963	Fleschmans Bayou, channel improvement, mile 0.0 to 10.0.
Lower White River, Ark.	July 1962	Pumping station.
Yazoo Basin Headwater, Miss.	Jan. 1963	Leflore County bridge, Greenwood protection works.
	Sept. 1962	East bank new levee, Belzoni to Snake Creek.
	Sept. 1962	East bank Pompey Ditch, levee setback (item 335–L).
	May 1963	West bank Pompey Ditch, levee setback (item 336–R).
	Sept. 1962	Greenwood cutoff and weir.
	Sept. 1962	Fort Loring cutoff.
	June 1963	State Highway 12 bridge, Tchula Lake cutoff.
	May 1963	Quiver River channel improvement, 9 cutoffs, mile 0.0 to 16.0.
	Aug. 1962	Bogue Phalia channel improvement, mile 0.0 to 8.5 and mile 21.0 to 30.0.
	Sept. 1962	Harris Bayou channel improvement, mile 0.0 to 21.0.
	Oct. 1962	Jones Bayou channel improvement, mile 0.0 to 7.7.
	July 1962	Jones Bayou, relocation of four Sunflower County bridges.
Big Sunflower River	July 1962	Channel improvement, mile 169.5 to 197.4.
	Aug. 1962	Channel improvement, mile 57.7 to 78.1 and mile 28.3 to 45.2.
Yazoo Basin Backwater, Miss.	Mar. 1963	New levee and connecting channel, items 4 and 5.
	May 1963	Relocation of U.S. Highway 61 bridge, item 7.

During the year preconstruction planning was continued on Mississippi River levee enlargement, bank protection, and on alluvial levees and channel improvements under construction. Such planning was also initiated on the following additional work:

Table 17. Project Features on Which Preconstruction Planning Was Initiated During Fiscal Year 1963

Project feature	Nature of project feature
Red River Backwater, La	Loop levee-Larto Lake to Jonesville, La.
Cache River, Ark	Channel improvement.

Incident to the construction of the project, the following features were maintained and operated during the year:

Table 18. Project Features on Which Maintenance and Operation Activities Were Conducted During Fiscal Year 1963

Project feature	Nature of project
Mississippi River	Levees, revetments, dikes, wavewash protection and dredging.
Atchafalaya Basin, La	Maintenance of levees and channels: Operation and maintenance: Locks: Bayou Sorrel. Bayou Boeuf. Berwick. Floodgates: Charenton. Calumet. Bayou Courtableau. Drainage structures: Wax Lake Outlet and numerous small structures.
Bonnet Carre Spillway, La	Levees, floodway and control structure.
Morganza Floodway, La	Floodway and control structure.
Old River Control, La	Maintenance of levees and channels: Operation and maintenance: Navigation lock. Control structures: Low sill. Overbank.
Lower Red River, La	Bank protection works.
Tensas Basin, La	Bayou Cocodrie drainage structure.
Yazoo Basin, Miss.:	
Yazoo Headwater	Levees and channels.
Greenwood	Local protection levees, storm water pumping station and drainage structures.
Yazoo City	Local protection levees, storm water pumping station and drainage structure.
Sardis Reservoir	Reservoir.
Arkabutla Reservoir	Do.
Enid Reservoir	Do.
Grenada Reservoir	Do.
St. Francis Basin, Mo.: Wappapello Reservoir.	Do.

Floods. Rains occurring over the Upper Mississippi and Ohio River basins in March 1963 produced crest stages at Cairo, Ill., and Memphis, Tenn., of 51.5 and 36.6 feet, respectively. These stages were 7.5 and 3 feet, respectively, above flood stage. Crest stages on the Mississippi River at other stations ranged from 9.5 feet below flood stage at Arkansas City, Ark., to 4 feet below flood stage at New Orleans, La. Red River crested at Alexandria, La., approximately 16 feet below flood stage. Crest stages on the Ouachita River were about 3.5 feet below flood stage at Arkadelphia, Ark., in September 1962 and March 1963; 2.9 feet below flood stage at Camden, Ark., in May 1963; and 19 feet below flood stage at Monroe, La., in March 1963. It is estimated that operation of Blakely Mountain Reservoir reduced the crest stage of the March rise at Arkadelphia by about 6.5 feet. Crest stages on lower Boeuf River were slightly above flood stage in April 1963. The Tensas River crested well below flood stage in April 1963. Black River crested 8 feet below flood stage in April 1963 at Jonesville, La.

The principal rise on the Coldwater-Tallahatchie-Yazoo Rivers occurred in March, April, and May, 1963 and crested at Swan Lake, Greenwood, and Yazoo City at stages of 4, 11, and 9 feet, respectively, below flood stage. Operation of flood control works effected reductions averaging 6.5 feet in Coldwater River, 6 feet on the Tallahatchie River at Swan Lake, and 2 feet on the Yazoo River at Greenwood. The Big Black River crested in March 1963 with stages slightly above flood stage in the upper reaches and well below flood stage in the lower portion.

The lower White River crested at Clarendon, Ark., on March 22–24, 1963, slightly below bankfull, being materially reduced by operation of upstream reservoirs.

The St. Francis River crested at St. Francis, Ark., on June 5, 1963, about 1 foot below bankfull. Operation of flood control works effected stage reductions above Lake City, Ark., ranging from 1 to 4 feet.

Crest stages occurred on the West Tennessee tributaries as follows: Obion River at Bogota, Tenn., 15.2 feet on March 16; North Fork of Forked Deer River at Dyersburg, Tenn., 22.1 feet on March 11; and Hatchie River at Rialto, Tenn., 13.8 feet on March 20. These stages were about 2, 8, and 2 feet, respectively, above flood stage. The Loosahatchie River crested at Brunswick, Tenn., on March 12 at 22.3 feet, about 1 foot above flood stage. Wolf River crested at Raleigh, Tenn., on March 11 at 13.8 feet, about 2 feet above flood stage.

Condition of overall project. At the end of the fiscal year, construction on the project as a whole between Cape Girardeau, Mo., and the Gulf of Mexico was about 67 percent complete. Work on

the main stem is sufficiently well advanced to afford a high degree of protection from Mississippi River flood overflow to most of the alluvial valley, except in unprotected backwater areas. A total of 1,724 miles of mainline levees containing 1,121 million cubic yards has been constructed, of which 1,573 miles, containing 1,047 million cubic yards, are along the Mississippi River, and the remainder along major tributaries (lower Arkansas and Red Rivers). A total of 1,624.5 miles of mainline levees has been enlarged to project grade and section. The bank stabilization program has progressed steadily during recent years through construction of bank revetments, dikes, and corrective dredging to prevent the river from regaining its former length due to its natural tendency to meander. A long-range plan is being developed to bring about and maintain the desired alinement of the river between Baton Rouge, La., and Cairo, Ill.

At the end of the fiscal year there were 490.8 miles of operative revetment and 189,100 linear feet of effective dikes on the Mississippi River below Cairo, Ill. Channel stabilization work on the Arkansas River adjacent to the project levee consists of 36.6 miles of revetment and 97,300 linear feet of dikes. Stabilization work on lower Red River and Atchafalaya River consists of 5.8 miles of revetment and 15,700 linear feet of dikes.

The Arkabutla, Sardis, Enid, and Grenada Reservoirs in the Yazoo Basin, Miss., and the Wappapello Reservoir in the Saint Francis Basin, Mo., have been completed. Other authorized improvements in the alluvial valley including levees, channel improvements, and supplementary drainage works are under construction. The Bonnet Carre, Morganza, West Atchafalaya and Atchafalaya Floodways are in a useful operational status, and with the Atchafalaya River will permit the diversion of 1,750,000 cubic feet per second of the project flood discharge to the Gulf of Mexico, leaving 1,250,000 cubic feet per second to pass down the main stem at New Orleans, La. Old River navigation lock, low sill, and overbank structures, with appurtenant entrance and exit channels, have been completed and are in operation. Work to be accomplished consists of the closure of the old channel of Old River adjacent to the lock, completion of the levee, and construction of bank stabilization works. The Old River control project will prevent the steadily enlarging channels of the Old and Atchafalaya Rivers from capturing the flow of the Mississippi River. The total benefits that have accrued since adoption of the project are estimated at more than $6 billion, which amounts to approximately $6 in benefits for every dollar of project funds so far expended.

The authorized Mississippi River and tributaries project, as amended, provides for a 12- by 300-foot navigation channel in the

Mississippi River between Baton Rouge, La., and Cairo, Ill., and a 12- by 125-foot channel in Old and Atchafalaya Rivers between the Mississippi River and Morgan City, La. The Mississippi River channel between Baton Rouge and Cairo was maintained to provide a dependable 9-foot depth for navigation except at the following locations: Henry Nye, Mo. (959 AHP), August 22–24, 1962, 6.5-foot depth; Lester, Ky. (911 AHP), August 20–22, 1962, 8-foot depth; Skull Bone, Tenn. (833 AHP), August 13–15, 1962, 8-foot depth; Finley Bar, Ark. (702 AHP), August 21–22, 1962, December 17–21, 1962, and January 28–February 2, 1963, 8-foot depth; Fox Burns, Miss. (687 AHP), August 15–16, 1962, 8-foot depth; Terrene Landing, Miss. (583.5 AHP), December 18–20, 1962, and February 3–4, 1963, 8-foot depth; entrance to Greenville Harbor (528.5 AHP), January 30–February 6, 1963, 8-foot depth. Commensurably greater depths were available during the high water season. The Atchafalaya River channel through Grand and Six-Mile Lakes between the Mississippi River and Morgan City, La., was maintained to provide adequate depth throughout the year.

Comprehensive review of Mississippi River and tributaries project. The comprehensive project review, authorized June 12, 1954, covering the need for navigation improvements on the main stem, the adequacy and cost of flood control features of the project and the coordination of these features with the plans of other Federal and State agencies for the development, conservation, and utilization of water resources in the alluvial valley, has been completed and is being submitted to Congress.

6. OPERATIONS (GENERAL)

Work done by contract. The Corps of Engineers consistently adheres to the policy of having construction work done by contractors wherever practicable. The hired labor work on construction projects has been limited to such types of operations as dredging in exposed harbor entrances by Government-owned hopper dredges, the construction of erosion-control and levee-revetment works, and grouting operations. The nature of such work does not readily lend itself to advertising and performance by contract.

Accident prevention. Injury rates both frequency and severity remained at a consistently low level. There was a slight improvement over the previous 4 years. The amount of damage to property and equipment was 51 percent below that for fiscal year 1962. Chart III shows injury rates for both Corps of Engineers and contractor employees.

Fire prevention. Government property and equipment losses by fire were $20,220 which resulted from nine incidents, a very slight increase over fiscal year 1962.

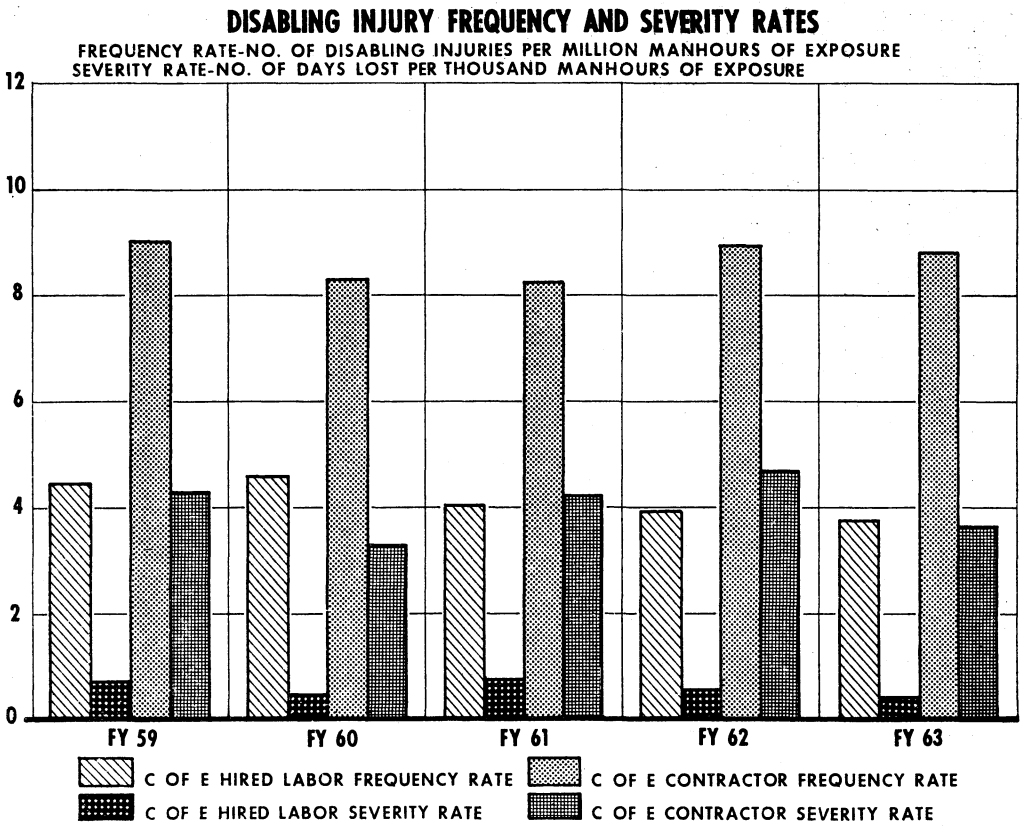
DISABLING INJURY FREQUENCY AND SEVERITY RATES
FREQUENCY RATE-NO. OF DISABLING INJURIES PER MILLION MANHOURS OF EXPOSURE
SEVERITY RATE-NO. OF DAYS LOST PER THOUSAND MANHOURS OF EXPOSURE
12
10
8
6
4
2
0
FY 59
FY 60
FY 61
FY 62
FY 63
C OF E HIRED LABOR FREQUENCY RATE
C OF E CONTRACTOR FREQUENCY RATE
C OF E HIRED LABOR SEVERITY RATE
C OF E CONTRACTOR SEVERITY RATE

CHART III

CHAPTER V

FUNDING

1. FUNDS AVAILABLE

Fiscal year 1963 funds appropriated for Civil Works activities of the Corps of Engineers amounted to $1,046,400,546. Individual appropriations are detailed in table 19. Status of the funds advanced by local interests for navigation and flood control improvements is shown in table 20.

Table 19. Appropriations, Fiscal Year 1963

The funds with which the works for the maintenance and improvement of rivers and harbors and flood control were prosecuted during the fiscal year were derived from unexpended balances of prior appropriations and from the following appropriations acts, and by transfer from other departments:

Appropriation title	Date of act	Amount
JOINT RESOLUTION:	July 1, 1962	
Flood control, Mississippi River and tributaries		$7,000,000
General investigations, Corps of Engineers, Civil		1,300,000
Construction, general, Corps of Engineers, Civil		60,000,000
Operation and maintenance, general, Corps of Engineers, Civil		12,000,000
General expenses, Corps of Engineers, Civil, 1963		1,100,000
U.S. Section, St. Lawrence River Joint Board of Engineers, Corps of Engineers, Civil, 1963		5,000
Total		81,405,000

Table 19. Appropriations, Fiscal Year 1963—Continued

Appropriation title	Date of act	Amount
JOINT RESOLUTION:	July 31, 1962	
Flood control, Mississippi River and tributaries		$7, 000, 000
General investigations, Corps of Engineers, Civil		1, 300, 000
Construction, general, Corps of Engineers, Civil		60, 000, 000
Operation and Maintenance, general, Corps of Engineers, Civil		12, 000, 000
General expenses, Corps of Engineers, Civil, 1963		1, 100, 000
U.S. Section, St. Lawrence River Joint Board of Engineers, Corps of Engineers, Civil, 1963		5, 000
Total		81, 405, 000
JOINT RESOLUTION:	Aug. 31, 1962	
Flood control, Mississippi River and tributaries		14, 000, 000
General investigations, Corps of Engineers, Civil		2, 000, 000
Construction, general, Corps of Engineers, Civil		120, 000, 000
Operation and maintenance, general, Corps of Engineers, Civil		24, 000, 000
General expenses, Corps of Engineers, Civil 1963		2, 000, 000
Total		162, 000, 000
PUBLIC WORKS APPROPRIATION ACT, 1962:	Oct. 24, 1962	
Flood control, Mississippi River and tributaries		45, 504, 000
General investigations, Corps of Engineers, Civil		13, 270, 300
Construction, general, Corps of Engineers, Civil		552, 845, 500
Operation and maintenance, General, Corps of Engineers, Civil		95, 539, 000
General expenses, Corps of Engineers, Civil, 1963		9, 380, 000
U.S. Section, St. Lawrence River Joint Board of Engineers, Corps of Engineers, Civil, 1963		10, 000
Total		716, 548, 800

Table 19. Appropriations, Fiscal Year 1963—Continued

Appropriation title	Date of act	Amount
SUPPLEMENTAL APPROPRIATION ACT, 1963:	May 17, 1963	
General investigations, Corps of Engineers, Civil		$229,700
Construction, general, Corps of Engineers, Civil		25,000
Operation and maintenance, general, Corps of Engineers, Civil		2,311,350
General Expenses, Corps of Engineers, Civil, 1963		585,200
Total		3,151,250
	Treasury Warrant No.	
SPECIAL FUNDS:		
Hydraulic mining in California, debris fund	578-96-5	18,000
Payments to States, Flood Control Act June 28, 1938, as Amended	810-96-8	1,718,769
Maintenance and operation of dams and other improvements to navigable waters (credits to accounts from licenses under Federal Water Power Act, Aug. 26, 1935)	801-96-7	153,727
Total		1,890,496
TRUST FUNDS (CONTRIBUTIONS AND ADVANCES):		
Rivers and Harbors contributed funds	Various	27,307,614
Rivers and Harbors advanced funds	do	258,250
Total		27,565,864

Table 19. Appropriations, Fiscal Year 1963—Continued

Appropriation title	Date of act	Amount
FUNDS TRANSFERRED FROM OTHER DEPARTMENTS:		
Consolidated working funds, Army, Engineers, Civil		$60, 752
Consolidated working funds, Army, Engineers, Civil, 1963		460, 000
Consolidated working funds, Army, Engineers, Civil, 1956–1964		14, 213
Construction, Bureau of Indian Affairs, Interior (transfer to Corps of Engineers, Civil)		383, 000
Construction, International Boundary and Water Commission, U.S. and Mexico, State (transfer to Corps of Engineers, Civil)		284, 926
Construction and rehabilitation, Bureau of Reclamation (transfer to Corps of Engineers, Civil)		*—18, 618
Disaster Relief, Executive Office of the President (transfer to Corps of Engineers, Civil)		*—1, 974
Federal-Aid Highways, Trust Fund, Treasury (transfer to Corps of Engineers, Civil)		110, 000
Public Works Acceleration, Executive (transfer to Corps of Engineers, Civil), 1963		10, 450, 000
U.S. dollar advances from Foreign Governments, U.S. Educational Exchange Program, State (transfer to Corps of Engineers, Civil)		700
Total		11, 742, 999
Grand total, all funds		1, 085, 709, 409

*Returned to originating agency.

Table 20. Advanced Funds, Fiscal Year 1963

The following amounts have been advanced by local interests for river and harbor improvements under the provisions of section II, River and Harbor Act, Mar. 3, 1925, and for flood control works under the provisions of the act of Oct. 15, 1940, and are returnable to the same interests when necessary Government funds are available.

	District	Balance due from United States, June 30, 1962	Amount received during fiscal year	Amount returned during fiscal year	Balance due from U.S. June 30, 1963
Selkirk Shores State Park, N.Y.	Buffalo	$4, 591			$4, 591
Cabrillo Beach, Calif.	Los Angeles	4, 330	$139, 070		143, 400
Donheny Beach, Calif.	do		1, 700		1, 700
Imperial Beach, Calif.	do	21, 330	17, 480	$19, 330	19, 480
Oceanside, Calif.	do	1, 002, 930			1, 002, 930
Ventura-Pierpont, Calif.	do	72, 333	100, 000		172, 333
Total rivers and harbors.		1, 105, 514	258, 250	19, 330	1, 344, 434

2. APPROPRIATIONS

Chart IV indicates the fluctuation in annual appropriations since 1953 for Civil Works functions.

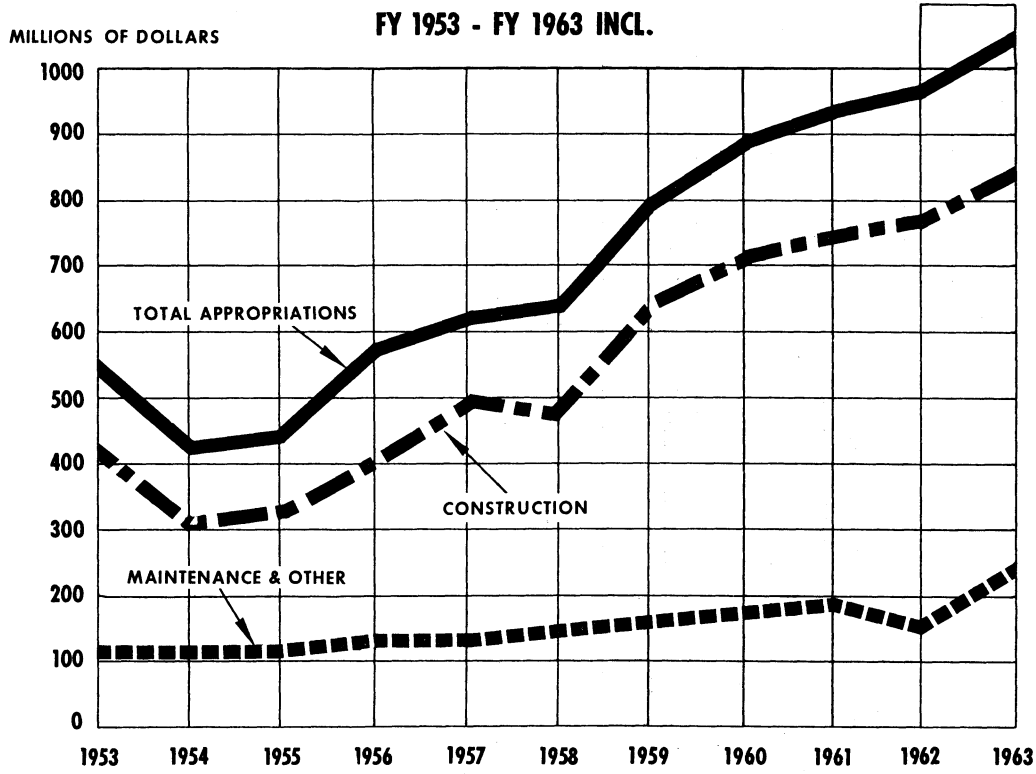
ACTUAL APPROPRIATIONS - CIVIL WORKS FUNCTIONS
FY 1953 - FY 1963 INCL.
MILLIONS OF DOLLARS
1000
900
800
700
600
500
400
300
200
100
0
TOTAL APPROPRIATIONS
CONSTRUCTION
MAINTENANCE & OTHER
1953
1954
1955
1956
1957
1958
1959
1960
1961
1962
1963

CHART IV

3. EXPENDITURES (COSTS)

During fiscal year 1963, expenditures (costs) amounted to $1,087,075,054 on the Civil Works program. Of this amount, $897,668,222 was for construction and $189,406,832 for all other activities except those funded by contingencies, advances, and collections from local sources and transfers from other agencies. Chart V shows comparative expenditure (cost) data since 1956. Expenditures under each appropriation are listed in table 21.

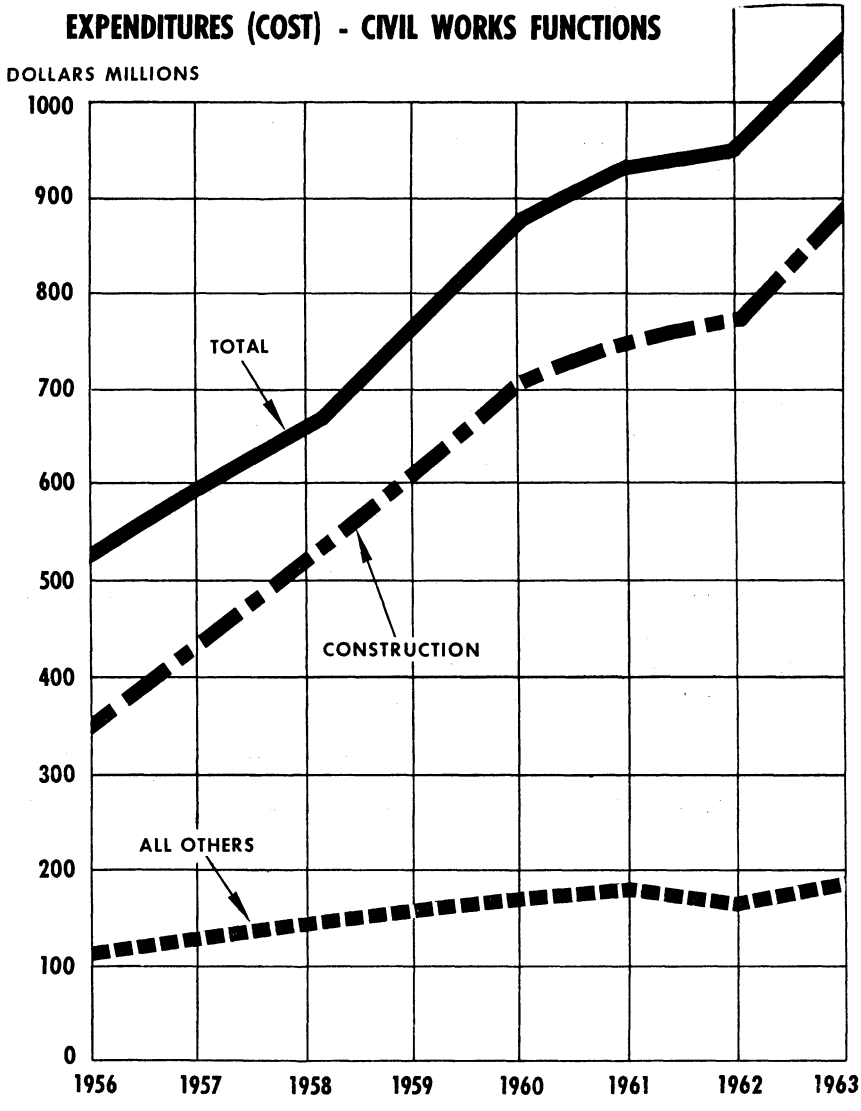

CHART V

Table 21. Accrued Expenditures, Fiscal Year 1963

The total actually expended under the direction of the Chief of Engineers in connection with the maintenance and improvement of rivers and harbors, flood control, and other miscellaneous works during fiscal year 1963 as follows:

Appropriation title	Amount
RIVERS AND HARBORS AND FLOOD CONTROL:	
Flood control, Mississippi River and tributaries	$82, 023, 869
General investigations, Corps of Engineers, Civil	16, 866, 579
Construction, general, Corps of Engineers, Civil	825, 956, 034
Operation and maintenance, general, Corps of Engineers, Civil	146, 887, 314
General expenses, Corps of Engineers, Civil, prior years	−128
General expenses, Corps of Engineers, Civil, 1961	456
General expenses, Corps of Engineers, Civil, 1962	91, 321
General expenses, Corps of Engineers, Civil, 1963	14, 066, 508
Maintenance and operation of dams and other improvements to navigable waters	153, 727
Total rivers and harbors and flood control	1, 086, 045, 680
MISCELLANEOUS APPROPRIATIONS:	
U.S. Section, St. Lawrence River Joint Board of Engineers, Corps of Engineers, Civil, 1963	2, 192
International Navigation Congresses, Corps of Engineers, Civil, 1961 and 1962	13, 521
Hydraulic mining in California, Civil	16, 801
Payments to States, Flood Control Act June 28, 1938, as amended	1, 613, 757
Total miscellaneous appropriations	1, 646, 271
CONTRIBUTED AND ADVANCED FUNDS:	
Rivers and Harbors, contributed funds	22, 549, 391
Rivers and Harbors, advanced funds	107, 242
Total contributed and advanced funds	22, 656, 633
Total appropriated and contributed funds	1, 110, 348, 584

Table 21. Accrued Expenditures, Fiscal Year 1963—Continued

Appropriation title	Amount
TRANSFERS FROM OTHER DEPARTMENTS:	
Capital outlay, U.S. Soldiers' Home (transfer to Corps of Engineers, Civil)	$392,302
Consolidated working funds, Army, Engineers, Civil	57,153
Consolidated working funds, Army, Engineers, Civil, 1962	16,500
Consolidated working funds, Army, Engineers, Civil, 1963	434,786
Consolidated working funds, Army, Engineers, Civil, 1956–1964	60,283
Construction, Bureau of Indian Affairs, Interior (transfer to Corps of Engineers, Civil)	23,438
Construction, International Boundary and Water Commission, U.S. and Mexico, State (transfer to Corps of Engineers, Civil)	403,668
Construction and rehabilitation, Bureau of Reclamation (transfer to Corps of Engineers, Civil)	74,364
Disaster Relief, Executive Office of the President (transfer to Corps of Engineers, Civil)	204
Federal-Aid Highways, Trust Fund, Treasury (transfer to Corps of Engineers, Civil)	122,977
Foreign Quarantine Activities, Public Health Service (transfer to Corps of Engineers, Civil)	557,864
Public Works Acceleration, Executive (transfer to Corps of Engineers, Civil), 1963	5,096,481
Passamaquoddy Tidal Power Survey (transfer to Corps of Engineers, Civil)	2,574
U.S. dollar advances from Foreign Governments, U.S. Educational Exchange Program, State (transfer to Corps of Engineers, Civil)	4,302
Total transfers from other Departments	7,246,896
Grand total, all funds	1,117,595,480

CHAPTER VI

OTHER ACTIVITIES

1. ST. LAWRENCE RIVER JOINT BOARD OF ENGINEERS

This Board, having United States and Canadian Sections, was created pursuant to the order of approval issued by the International Joint Commission on October 29, 1952. The U.S. Section was established and its duties defined by an Executive order issued November 4, 1953. Members of the U.S. Section are the Secretary of the Army and the Chairman of the Federal Power Commission. Maj. Gen. C. G. Holle (Ret.) (retained on a consultant basis) served as alternate to act for the Secretary of the Army throughout the year, and Mr. H. M. Hay served as alternate for the Chairman of the Federal Power Commission.

The duties of the Board are to review and approve, in behalf of both Federal Governments, the plans, specifications, and work schedules for the power project in the International Rapids section of the St. Lawrence River, and to inspect construction operations to insure conformance with Board approvals. The power project was constructed jointly by the Power Authority of the State of New York and The Hydro-Electric Power Commission of Ontario. Supervision of construction pursuant to the Federal Power Commission license issued July 15, 1953, to the Power Authority of the State of New York, also was assigned to the U.S. Section, thus integrating these two Federal supervisory activities.

A small engineering staff to support the U.S. Section was established in Massena, N.Y., on July 1, 1954, with Washington liaison. In consideration of the advanced stage of construction of the power project, the Massena office was closed on August 8, 1958, with staff support thereafter being provided in the Office of the Chief of Engineers and the Washington office of the Federal Power Commission.

Costs of the U.S. Section through June 30, 1963, totaled about $444,000. All costs of the U.S. Section are subject to reimbursement by the Power Authority of the State of New York, as provided in the appropriation acts.

2. FLOOD FIGHTING AND OTHER EMERGENCY OPERATIONS

Emergency flood control and shore protection activities were carried on during the year pursuant to authority in Public Law 99,

84th Congress, as amended by section 206, Flood Control Act of 1962. These activities included: Advance preparation for flood emergencies; flood fighting and rescue work; and the repair and restoration of flood control works damaged by flood, and of federally authorized shore protection works damaged by storm. Fiscal year expenditures from the emergency fund totaled $5,451,282. Disaster assistance, primarily in the form of engineering and construction services, was made available at the scene of major disasters as authorized and directed by the Office of Emergency Planning (OEP), acting in behalf of the President, in accordance with procedures established pursuant to Public Law 875, 81st Congress (Federal Disaster Act of 1950). The most noteworthy emergency operations during the fiscal year are described in following paragraphs.

Operation "Chlorine." The Corps of Engineers successfully salvaged four tanks of liquid chlorine from the barge *Wychem* 112 which sank in the Mississippi River below Natchez, Miss. Contract for this work, for which the Corps assumed responsibility at the request of the Director, OEP, was awarded September 29, 1962. The last tank was removed November 5. Direct Corps of Engineer costs for this disaster operation, authorized and funded under Public Law 875, were $1,571,000.

October 1962 windstorm in Oregon and Washington. On October 12, 1962, a severe windstorm, which struck western Oregon and Washington with winds of velocities up to 130 miles per hour, caused extensive damage estimated at $170 million in Oregon alone. The effects on the western portions of the two States were determined a "major disaster" by the President, under Public Law 875. At OEP request, the Corps furnished engineering administrative assistance, and performed emergency channel clearance work, at an estimated $290,000 total cost.

November 1962 Florida coastal storm. During late November 1962, a severe coastal storm of several days' duration caused heavy damage along the shores of communities near Jacksonville, Fla. The President issued a "major disaster" declaration under Public Law 875 for areas of Florida adversely affected. At the request of the OEP, acting for the President, the Corps of Engineers had earlier surveyed the damage and furnished estimates for temporary emergency measures. Acting upon subsequent OEP requests, the Corps of Engineers undertook disaster assistance consisting of emergency shore protective work and restoration of essential public facilities in Duval and St. Johns Counties. Estimated to cost $1,300,000, more than 90 percent of the work requested by the OEP was completed at the end of the fiscal year.

February 1963 floods in western United States. Heavy rains beginning January 28, 1963, caused flooding during early February along many streams of the Far Western States. Damage in California was scattered; below the foothill line, flood damages were estimated at $13 million. In Nevada, flood stages were reached on the Truckee, Carson, and Walker Rivers; flooding of 30 blocks in downtown Reno and various rural areas resulted in damages totaling more than $3 million. In early February, heavy precipitation, high temperatures, and snowmelt caused flooding and ice jams in the interior basins of Oregon, Washington, Idaho, and western Montana. Flood damages, including destruction of several bridges, were estimated at $5 million. The President issued "major disaster" declarations under Public Law 875 regarding the affected areas in California, Washington, Oregon, and Nevada. Requested administrative engineering assistance was provided by the Corps to the OEP, and emergency channel clearance and other disaster recovery work was undertaken as authorized by the OEP in California and Nevada. Repair of damaged flood control works in California was initiated under Public Law 99 authority.

March 1963 floods in the Ohio River Basin. Concurrent snowmelt and a series of heavy rains during most of March resulted in flood stages along many streams of the Ohio River Basin. At Cincinnati, the Ohio River remained above flood stage for 22 consecutive days, a period 3 days longer than during the record floods of 1937. Total flood damage in the Ohio River Basin was estimated at $100 million. The President issued a "major disaster" declaration under Public Law 875 regarding severely affected areas of Kentucky, West Virginia, Virginia, and Tennessee. The Corps provided engineering advice and assistance to local interests during the high-water period, and aided the OEP in regard to Public Law 875 disaster assistance.

April 1962 floods in Hawaii. Local flooding on Kauai and Oahu, the northern islands of Hawaii, was caused by a very heavy rainstorm climaxing a 3-week period of nearly continuous rain. On April 15 there was reportedly up to 18 inches of rainfall during an 8-hour period, and this storm was considered to be the heaviest to hit the northern islands in many years. Total storm damage, principally on Oahu, was estimated at $2,325,000; the President declared a "major disaster" under Public Law 875 regarding the areas affected. Administrative engineering assistance was furnished the OEP.

June 1963 flood in southeastern Nebraska. Heavy rainfall on June 23–24 over southeastern Nebraska caused severe flooding in the Salt Creek and upper Big Blue River Basins, with damages estimated to total more than $1 million. Severe damage was sustained by the Nebraska communities of DeWitt, Memphis, Valparaiso, Wahoo, and

Ashland. The President declared a "major disaster" under Public Law 875 regarding the affected areas in Nebraska. Flood-fighting assistance was provided and emergency repair work was initiated by the Corps under Public Law 99 authority.

3. PROTECTION OF NAVIGABLE WATERS

In administering the Federal laws enacted for the protection and preservation of the navigable waters of the United States, 6,364 permits for structures or operations in navigable waters were issued and plans for 143 bridges, dams, dikes, or causeways were approved during the year. In addition, 26 extensions of time for commencement or completion of construction of bridges were granted. Sixty-five sets of regulations for the use, administration, and navigation of navigable waters were established, including drawbridge regulations, establishment of anchorage grounds, special anchorage areas, danger zones, and restricted areas.

The Corps of Engineers engaged in the following additional activities relative to the administration of the laws for the protection of navigable waters: Investigations of the discharge or deposit of refuse matter of any kind in navigable waters; prevention of pollution of coastal navigable waters by oil; administrative determination of the heads of navigation and the extent to which the laws shall apply to specific streams; supervision of the harbors of New York, Hampton Roads, and Baltimore to prevent obstructive and injurious deposits in the waters thereof, including the waters of Long Island Sound; establishment of reasonable rates of toll for transit across bridges over navigable waters; granting of permits for the occupation and use of Federal works under control of the Corps of Engineers; report of international boards on operations affecting international boundary waters; legislation in connection with the foregoing, and prevention and removal of any deposits in channels which obstruct navigation or increase Federal maintenance costs. The program has resulted not only in a saving in dredging costs and more efficient use of dredging equipment, but also in a stimulation of planning by the industries to improve their operations for recovering salvageable material. In the case of one company, which declined to accept responsibility for its deposits in the Calumet River, Ill., court action was instituted in 1954. Decree was entered June 24, 1957, by the District Court in favor of the United States. The defendant was ordered to stop the deposit of materials and to remove the accumulation within 6 months. The defendant appealed the case and on January 22, 1959, the Court of Appeals reversed the District Court on the grounds that the River and Harbor Act of 1899, 33 U.S.C. 401, et seq., did not provide an

injunctive remedy to enjoin such discharges, and that the industrial discharges come within the exception permitting discharges of sewage in a liquid state into navigable waters. On June 1, 1959, the Supreme Court agreed to review the case, and on May 16, 1960, reversed the judgment of the Appeals Court and remanded the case to the Court of Appeals for review of the evidence. The Court of Appeals ordered a new trial because improper evidence had been introduced at the trial. Because a new trial would involve complex and difficult issues of fact, negotiations were started with the defendant to effect a settlement of the case. The Corps of Engineers is making a thorough review of its policy on bridge clearances with a view to resolving problems involved in meeting the requirements of both water and land transportation interests. The present system of standard bridge clearances is being reviewed and extended to cover, insofar as practicable and necessary, all navigable waterways. During the fiscal year 1963 the study for the purpose of establishing vertical clearance standards for the Sacramento River from the "W–X" Street bridge site upstream to Colusa was continued. In view of the lock and dam modernization program on the Ohio River affecting existing pool elevations, an economic study was also started to determine whether the present standards should be modified. On January 4, 1963, the Chief of Engineers approved a vertical clearance standard of 52 feet above the 2-percent line for the entire reach of the Arkansas River and tributaries navigation project with a horizontal guide clearance of 300 feet for the Arkansas River from its mouth to the mouth of the Verdigris River and 200 feet for the Verdigris River from its mouth to the head of navigation at Catoosa, Okla. On March 21, 1963, the Chief of Engineers approved a vertical clearance standard of 52 feet above levels reached or exceeded 2 percent of the navigation season and a horizontal clearance standard of 400 feet for the entire reach of the Missouri River from its mouth to Gavins Point Dam.

Under the Bridge Alteration Act (Truman-Hobbs) approved June 21, 1940, as amended by the act of July 16, 1952, the cost of altering a bridge used for railroad traffic, combined railroad and highway traffic or a publicly owned highway bridge, found by the Secretary of the Army to be obstructive to navigation, is apportioned between the bridge owner and the United States. Hearings in connection with obstructive qualities are held to determine if the bridge is an unreasonable obstruction to navigation. During fiscal year 1963, two hearings were held on obstructive bridges. Funds have been made available for continuation of alteration on three bridges. Action was continued on five additional obstructive bridge cases in various stages of development.

The removal of wrecks in navigable waters of the United States is governed by sections 19 and 20 of the River and Harbor Act approved March 3, 1899, and is predicated entirely upon their being obstructions to navigation. During the fiscal year, 81 wrecks were removed by the Corps of Engineers as obstructions to navigation.

4. HYDRAULIC MINING, CALIFORNIA

The California Debris Commission created by act of Congress regulates hydraulic mining in the drainage area of the Sacramento and San Joaquin Rivers to prevent the resulting debris from being carried into navigable waters. The Commission currently has nine licensed mining operators, of which three utilize storage behind the Federal debris dams.

During the year, the Harry L. Englebright Dam and the North Fork Dam, together with their appurtenant service facilities, were operated and maintained for the storage of hydraulic mining debris.

Work accomplished on the Yuba River early in the fiscal year by contract consisted of bank protection, both banks, Yuba River, vicinity of Simpson Lane and Dredge Tailings, in Yuba County. The cost of this activity was paid in part from funds provided from receipts of required contributed funds.

During the February 1963 high water the center section, approximately 125 feet in extent failed, on Daguerre Point Dam, Yuba River. Studies, including explorations and surveys, indicated that it would not be practical to restore only the failed center section, as the remaining portions of the overflow section of the dam are considered to be unstable. Rehabilitation will be accomplished by replacing the existing wood and concrete structure with a concrete gravity dam. The report on method of rehabilitation was approved May 7, 1963. The report included an estimate (July 1963) for the proposed plan in the amount of $1,800,000, of which one-half is to be reimbursed by the State of California. State of California Senate bill No. 1124, approved by the Governor May 24, 1963 (ch. 572), will make the required contributed funds available. Bids were advertised during June 1963 and award of the contract is scheduled for July 1963. Construction is scheduled to be completed within the next construction season which ends on or about the middle of November 1963 and would meet the objective of having the dam operational during the 1963–64 flood season.

5. NUCLEAR EXPLOSIVE STUDIES FOR CIVIL CONSTRUCTION

In 1962 the Corps of Engineers joined with the Atomic Energy Commission Plowshare program to develop the use of nuclear explosives for large-scale excavation. In the joint program the Corps is

responsible for conducting small-scale cratering experiments and for development of the requisite data on engineering and construction problems.

The research and investigation of the Corps generally divide into three areas: (1) Investigations of engineering properties of nuclear craters; (2) small-scale cratering experiments; and (3) engineering studies of project feasibility. The program cost in fiscal year 1962 was $500,000. A small-scale cratering experiment, Pre-Buggy, was conducted at the Nevada Test Site to extend current knowledge on crater dimensions and venting of explosion products from a row of charges detonated simultaneously. Preshot and postshop explorations were conducted at the Danny Boy and Sedan nuclear crater sites.

The U.S. Army Nuclear Cratering Group was established at Lawrence Radiation Laboratory, Livermore, Calif., to provide technical management of the program. The U.S. Army Engineer Waterways Experiment Station, Vicksburg, Miss., supports the Nuclear Cratering Group in investigations and studies. Selected divisions and districts participate in the program as required.

6. LAKE SURVEY

The U.S. Lake Survey, under its authorized project, continued the program of preparing, revising, and distributing navigation charts of the Great Lakes and their outflow rivers, the New York State barge canals, Lake Champlain, and the Minnesota-Ontario border lakes, including bound volumes of large-scale charts primarily for recreational use. The Great Lakes Pilot and seven monthly supplements thereto, publications which complement information shown on the charts, were compiled and issued. Information was gathered and study continued on matters affecting the applied hydraulics and hydrology of the Great Lakes.

The Chief of Engineers on December 20, 1962, authorized the establishment of a Lake Survey Research Division to provide for research and investigation of all aspects of "fresh-water" oceanography and related scientific fields pertinent to the development and improved utilization of the water resources of the Great Lakes system. Work under this program was initiated on a modest scale during the year.

Hydrographic surveys were conducted in tributaries of the Great Lakes and revisory surveys were conducted in harbors and other critical areas along the northern and eastern coasts of Lake Michigan; at selected harbors on Lakes Erie, Huron, and Superior; and on the Minnesota-Ontario border lakes. Similar surveys were made on the St. Clair River and along the U.S. shore of Lake St. Clair. Main-

tenance of the vertical control network in appropriate areas was accomplished coincident with the revisory survey program.

Horizontal control was established, and vertical control verified in certain areas by special water gages during the year. Also discharge measurements were made and water-level data collected at permanent gaging stations. In addition, many data of a hydraulic and hydrologic nature were collected, reduced, tabulated, and disseminated.

7. WASHINGTON, D.C., WATER SUPPLY

With funds appropriated for the District of Columbia, the Corps of Engineers continued the operation, maintenance, repair, and protection of the water supply facilities, known as the Washington Aqueduct, to provide an uninterrupted and adequate supply of purified water to the distribution systems of the District of Columbia and adjacent Maryland and Virginia areas as authorized by law. The maximum daily consumption provided by the existing facilities was 238 million gallons and the average daily consumption was 166 million gallons.

In order to meet the future demands for water, construction work continued on the long-range program. Construction of the new Dalecarlia filter and chemical buildings by contract continued and the work is scheduled to be completed in the fall of 1963.

For detailed report on maintenance, operation, and capital outlay of the Washington, D.C., water supply facilities, see volume 2, "Baltimore District."

8. FOREIGN TECHNICAL ASSISTANCE

The Corps of Engineers continued to participate in the foreign technical assistance program of the Department of State, the Agency for International Development, and the United Nations. This participation entailed the inservice training of selected engineers from foreign governments, the short-time detailing of technical specialists to provide technical assistance for Civil Works projects in foreign countries in support of AID programs, the accommodation of visiting foreign nationals at Civil Works projects and activities, and the provision of engineering information and literature relating to the development of water resources.

During the fiscal year, training in navigation development, flood control, hydroelectric power development, and other water resource development activities was provided foreign nationals from the following countries:

Chile	Egypt
China (Taiwan)	India
Colombia	Iraq
East Africa	Vietnam

In addition, the Corps of Engineers received foreign government representatives and engineers and afforded them the opportunity to visit the Corps Civil Works offices and projects to observe construction, organization, and techniques. Foreign nationals from the following countries were among those visiting Civil Works activities and Corps of Engineers installations:

Australia	Japan
Brazil	Mexico
England	New Zealand
Egypt	Pakistan
Finland	Saudi Arabia
France	Spain
India	Taiwan
Indonesia	

Upon request, engineering information pertaining to the Corps Civil Works program was furnished to foreign engineers and government representatives.

9. PUBLICATIONS

The following publications pertaining to Civil Works activities have been issued.

A. Available at the Government Printing Office, Washington, D.C., 20402, at indicated price:

1. Port Series:
   - No. 46—The Port of Chicago, Ill $1.75
   - No. 47—The Port of Milwaukee, Wis 1.00
   - No. 48—The Ports on Lake Michigan (Indiana Harbor, Ind., Muskegon and Escanaba, Mich., Manitowoc and Green Bay, Wis.) 1.75
   - No. 49—The Ports of Duluth-Superior, Minn. and Wis. Two Harbors, Minn., and Ashland, Wis 1.50
2. Transportation Series:
   - No. 3—Transportation Lines on the Great Lakes System, 1963 ..... .60
   - No. 4—Transportation Lines on the Mississippi River System and the Gulf Intercoastal Waterway, 1962 ..... 2.25
   - No. 5—Transportation Lines on the Atlantic, Gulf, and Pacific Coasts, 1962 ..... 3.25
3. Engineer Manuals:
   - EM 1110-2-1000, Photogrammetric Mapping ..... .40
   - EM 1110-2-1905, Design of Finite Relief Well Systems 1.25
   - EM 1110-2-2701, Vertical Lift Crest Gates ..... .75
   - EM 1110-2-2904, Design of Breakwaters and Jetties ..... .75
   - EM 1110-2-3101, Pumping Stations—Local Cooperation and General Considerations 1.00
   - EM 1110-2-3102, General Principles of Pumping Station Design and Layout 1.25
   - EM 1110-2-3105, Mechanical and Electrical Design of Pumping Stations 2.25

B. Available at place of publication at listed price or as indicated:

1. Great Lakes Pilot, 1963, U.S. Army Engineer District, Lake Survey, Detroit, Mich., 48226 (including supplements)..... $2.50
2. Waterborne Commerce of the United States, calendar year 1962:
   - Part 1—Waterways and Harbors: Atlantic Coast. U.S. Army Engineer Division, New England, Waltham, Mass., or U.S. Army Engineer District, Lake Survey, Detroit, Mich., 48226..... 1.40
   - Part 2—Waterways and Harbors: Gulf Coast, Mississippi River System and Antilles. U.S. Army Engineer District, Vicksburg, Miss., 39181; U.S. Army Engineer District, New Orleans, La., 70160; or U.S. Army Engineer District, Lake Survey, Detroit, Mich., 48226..... 1.50
   - Part 3—Waterways and Harbors: Great Lakes, U.S. Army Engineer District, Lake Survey, Detroit, Mich., 48226..... 1.25
   - Part 4—Waterways and Harbors: Pacific Coast, Alaska and Hawaii. U.S. Army Engineer District, San Francisco, Calif., 94105, or U.S. Army Engineer District, Lake Survey, Detroit, Mich., 48226..... 1.20
   - Part 5—National Summaries. U.S. Army Engineer District, Lake Survey, Detroit, Mich., 48226..... .30

10. DIRECTORY OF INSTALLATIONS AND ACTIVITIES

A. Divisions and Districts:

U.S. Army Engineer Division, Lower Mississippi Valley, Post Office Box 80, Vicksburg, Miss., 39181
- U.S. Army Engineer District, Memphis, Post Office Box 97, Memphis, Tenn., 38101
- U.S. Army Engineer District, New Orleans, Post Office Box 60267, New Orleans, La., 70160
- U.S. Army Engineer District, St. Louis, 420 Locust Street, St. Louis, Mo., 63102
- U.S. Army Engineer District, Vicksburg, Post Office Box 60, Vicksburg, Miss., 39181

U.S. Army Engineer Division, Missouri River, Post Office Box 1216, Downtown Station, Omaha, Nebr., 68101
- U.S. Army Engineer District, Kansas City, 1800 Federal Office Building, Kansas City, Mo., 64106
- U.S. Army Engineer District, Omaha, 215 North 17th Street, Omaha, Nebr., 68102

U.S. Army Engineer Division, New England, 424 Trapelo Road, Waltham, Mass., 02154

U.S. Army Engineer Division, North Atlantic, 90 Church Street, New York, N.Y., 10007
- U.S. Army Engineer District, Baltimore, Post Office Box 1715, Baltimore, Md., 21203
- U.S. Army Engineer District, New York, 111 East 16th Street, New York, N.Y., 10003

U.S. Army Engineer District, Norfolk, Foot of Front Street, Norfolk, Va., 23510

U.S. Army Engineer District, Philadelphia, Post Office Box 8629, Philadelphia, Pa., 19106

U.S. Army Engineer Division, North Central, 536 South Clark Street, Chicago, Ill., 60605

U.S. Army Engineer District, Buffalo, Foot of Bridge Street, Buffalo, N.Y., 14207

U.S. Army Engineer District, Chicago, 536 South Clark Street, Chicago, Ill., 60605

U.S. Army Engineer District, Detroit, Post Office Box 1027, Detroit, Mich., 48231

U.S. Army Engineer District, Rock Island, Clock Tower Building, Rock Island, Ill., 61202

U.S. Army Engineer District, St. Paul, 180 East Kellog Boulevard, St. Paul, Minn., 55101

U.S. Army Engineer District, Lake Survey, 630 Federal Building, Detroit, Mich., 48226

U.S. Army Engineer Division, North Pacific, 210 Custom House, Portland, Oreg., 97209

U.S. Army Engineer District, Portland, 628 Pittock Block, Portland, Oreg., 97205

U.S. Army Engineer District, Alaska, Post Office Box 7002, Anchorage, Alaska, 99501

U.S. Army Engineer District, Seattle, 1519 Alaskan Way, South, Seattle, Wash., 98134

U.S. Army Engineer District, Walla Walla, Building 602, City-County Airport, Walla Walla, Wash., 99362

U.S. Army Engineer Division, Ohio River, Post Office Box 1159, Cincinnati, Ohio, 45201

U.S. Army Engineer District, Huntington, Post Office Box 2127, Huntington, W. Va., 25721

U.S. Army Engineer District, Louisville, Post Office Box 59, Louisville, Ky., 40201

U.S. Army Engineer District, Nashville, Post Office Box 1070, Nashville, Tenn., 37202

U.S. Army Engineer District, Pittsburgh, Manor Building, 564 Forbes Avenue, Pittsburgh, Pa., 15219

U.S. Army Engineer Division, Pacific Ocean, Building 96, Fort Armstrong, Honolulu, Hawaii, 96813

U.S. Army Engineer District, Honolulu, Building 96, Fort Armstrong, Honolulu, Hawaii, 96813

U.S. Army Engineer Division, South Atlantic, Post Office Box 1889, Atlanta, Ga., 30301

U.S. Army Engineer District, Charleston, Post Office Box 905, Charleston., S.C., 29402

U.S. Army Engineer District, Jacksonville, Post Office Box 4970, Jacksonville, Fla., 32201

U.S. Army Engineer District, Mobile, Post Office Box 1169, Mobile, Ala., 36601

U.S. Army Engineer District, Savannah, Post Office Box 889, Savannah, Ga., 31402

722-373—64——7

U.S. Army Engineer District, Wilmington, Post Office Box 1890, Wilmington, N.C., 28402

U.S. Army Engineer Division, South Pacific, 630 Sansome Street, San Francisco, Calif., 94111

U.S. Army Engineer District, Los Angeles, Post Office Box 17277, Foy Station, Los Angeles, Calif., 90017

U.S. Army Engineer District, Sacramento, Post Office Box 1739, Sacramento, Calif., 95808

U.S. Army Engineer District, San Francisco, 180 New Montgomery Street, San Francisco, Calif., 94105

U.S. Army Engineer Division, Southwestern, 1114 Commerce Street, Dallas, Tex., 75202

U.S. Army Engineer District, Albuquerque, Post Office Box 1538, Albuquerque, N. Mex., 87103

U.S. Army Engineer District, Forth Worth, Post Office Box 1600, Fort Worth, Tex., 76101

U.S. Army Engineer District, Galveston, Post Office Box 1229, Galveston, Tex., 77551

U.S. Army Engineer District, Little Rock, Post Office Box 867, Little Rock, Ark., 72203

U.S. Army Engineer District, Tulsa, Post Office Box 61, Tulsa, Okla., 74102

B. Boards, Commissions and Stations:

The Beach Erosion Board, 5201 Little Falls Road NW., Washington, D.C., 20016

California Debris Commission, Post Office Box 1739, Sacramento, Calif.

Mississippi River Commission, Post Office Box 80, Vicksburg, Miss., 39181

Board of Engineers for Rivers and Harbors, Tempo C Building, 2d and Q Streets SW., Washington, D.C., 20315

U.S. Army Engineer Waterways Experiment Station, Post Office Box 631, Vicksburg, Miss., 39181

C. International Boards and Commissions:

International Joint Commission, United States and Canada; Secretary, United States Section, William A. Bullard, Room 788, Federal Trade Building, 7th Street and Pennsylvania Avenue NW., Washington, D.C., 20440

International Columbia River Engineering Board, United States and Canada

International Passamaquoddy Engineering Board, United States and Canada

International St. Croix River Engineering Board, United States and Canada

International Champlain Waterway Board, United States and Canada; Secretary, United States Section, John W. Roche, Office, Chief of Engineers, U.S. Army, Washington, D.C., 20315

International Pembina River Engineering Board, United States and Canada; Secretary, United States Section, Leon Maca, Department of the Interior, Washington, D.C., 20240

International Saint John River Engineering Board, United States and Canada; Secretary, United States Section, Wallace T. Miller, Geological Survey, Department of the Interior, Washington, D.C., 20240

International Boundary and Water Commission, United States and Mexico; Secretary, United States Section, Joe D. Walstrom, Mart Building, El Paso, Tex.

Chapter VII

ECONOMY MEASURES

During fiscal year 1963 the program to reduce costs, improve operations, and increase productivity has continued to provide economies in the Corps activities.

Organization. Personnel economies have been effected by having selected technical and administrative support furnished to a smaller district office by another nearby office. This was accomplished in Charleston, S.C., and Wilmington, N.C., and in the Eastern Ocean District in New York City.

Where feasible, specific activities are consolidated on a regional basis so that a more productive workload may be realized and the benefits of higher speed mechanized systems may be brought into play. As a result of consolidating payroll activities on a regional basis for the Corps' 48,000 civilian employees, annual costs for this service have been cut by almost $390,000. Productivity more than doubled following installation of the new system several years ago, making it possible to cut 145 employees from this activity and producing a current production rate that is roughly 20 percent greater than the highest standard rate set by the Department of the Army.

Savings in supervision and administration costs. Since fiscal year 1960, Civil Works construction has risen from $607 million to $755 million a year, an increase of 24 percent. However, during this same period the funds required for supervision and administration were reduced by 15 percent in spite of an increase, during that period, in pay scales, and insurance and health benefits amounting to 16 percent. The actual saving in this connection for fiscal years 1960–63 was $20.6 million.

Management improvement program. This program has been very productive and has effected substantial economies in the utilization of appropriated funds. Since fiscal year 1956 the combined Military and Civil Works programs have realized benefits amounting to $146.7 million. Examples of some Civil Works projects on which improved operations or cost reductions were made possible during fiscal year 1963 are as follows:

At the Ice Harbor, Lower Monumental, and John Day projects, design changes for the cofferdams as a result of thorough engineering studies have reduced construction costs some $5 million and advanced

construction schedules by substituting rockfill cofferdams for steel cells which had been used in earlier stages.

Initial plans for the Matagorda ship canal called for an entrance channel to be located at Pass Cavallo, the natural entrance to Matagorda Bay. A model study was undertaken to analyze in advance of project construction the effects of alternate construction possibilities. Benefits from this investigation resulted in the selection of a straighter channel, 2.5 miles shorter, which will provide less hazard to navigation and faster travel by vessels and lower costs for other features which will approximate a savings of $7 million.

Louisville District accelerated preparation of contract drawings by cutting and joining sections of negatives prepared from earlier plans to obtain an accurate reproducible positive and also by the use of Diazo prints. This method effected a saving of $4,000.

Revised staffing pattern for lock operations, effected on the Tennessee and Cumberland Rivers in the Nashville District, was made possible by improved laborsaving and safety devices and institution of one-man shifts for lock operations in lieu of two-man shifts. This modification resulted in a saving of about $80,000.

Employee suggestions. During the past 5 years, Corps of Engineers employees have had 13,495 suggestions adopted for which they received $300,000 in cash awards. Savings to the Government, as a result of these suggestions, totaled $5.58 million.

Special recognition. In addition to payment of awards for adopted suggestions and for special acts or services, the Department of the Army operates an active awards program for recognizing and honoring specific professional and other exceptional and outstanding attainments. During fiscal year 1963 the following were included among the 34 Corps of Engineers employees so honored:

Special recognition was granted an employee of the U.S. Army Waterways Experiment Station for her accomplishment in the application of petrography to research on concrete and concrete materials. This employee was one among a total of only six employees selected from the entire Federal service to receive the Federal Woman's Award for fiscal year 1963. In addition, this Corps of Engineers employee is the first woman in the entire Department of Defense to receive this honor.

The top civilian award of the Department of the Army, the Exceptional Civilian Service Award, was granted during fiscal year 1963 to an employee of the Office, Chief of Engineers, who received this award for his contributions in the field of electric power, which over the years has saved the Government $21 million.

Floating and other plant operations. Improvement of efficiency and utilization of existing plant is constantly maintained as well as

replacement of obsolete units. Following are samples of such improvements:

The hopper dredge *Comber* has recently been converted to a direct pumpout unit, and the hopper dredge *Goethals* is being redesigned to provide this feature. As a result of these conversions, the sump rehandler *New Orleans*, a modified hopper dredge, will be disposed of, with the resultant savings due to fewer personnel and less equipment necessary to accomplish the dredging and pump ashore operations, formerly carried out by the *Comber* and *Goethals* in combination with the *New Orleans*. The replacement of the *New Orleans*, at an estimated cost of $8 million, is also eliminated.

By a continuous program of improving operations and eliminating high-cost overage vehicles, the Corps of Engineers has reduced the maintenance costs of vehicles to 2.5 cents per mile as compared to the Army-wide average of 5.2 cents per mile.

Supply. A program for locating and utilizing available items of engineer and construction equipment obtained without reimbursement from other Federal agencies has augmented the acquisition of Civil Works plant in the past several years as follows:

Fiscal year	Original cost of plant	Transport and conversion costs	Net savings to Corps
1960	$6, 769, 000	$1, 052, 000	$5, 717, 000
1961	12, 519, 600	937, 000	11, 582, 600
1962	5, 860, 250	328, 500	5, 531, 750
1963	6, 555, 000	773, 500	5, 781, 500
Total	31, 703, 850	3, 091, 000	28, 612, 850

The above savings do not include economies realized by the acquisition of surplus equipment acquired by individual engineer districts.

Automatic data processing. Computers and punched-card equipment are being used on a wide range of engineering and business problems. In most earthwork programs, it is estimated that 30 minutes of computer time is equivalent to 25 engineering hours of like work. Foundation and material engineers, by means of a recently developed computer program, are able to accomplish the many two-dimensional heat flow studies required for stress analysis and for the design of cooling pipe spacing for mass concrete cooling without the use of additional personnel. Each study accomplished by the computer, in this connection, in 4 hours' time, is comparable to approximately 2½ man-years of computation if done manually.

Chapter VIII

WATERBORNE COMMERCE

Substantial gains were recorded in the waterborne commerce of the United States during 1962. Tonnage rose 67 million tons, 6.3 percent, to a total of 1,129 million, only 2 million tons short of the record total in 1957. Ton-miles at 223 billion in 1962 showed a similar relative increase of 6.3 percent over the 210 billion the previous year and was also second to the peak of 231 billion in 1957. The relatively lower increase in ton-miles than tons, 1962 compared with 1957, is explained by the decline in domestic lakewise traffic during this period despite the gains in other types of traffic; average hauls in the lakes traffic are considerably higher than in the other trades on the inland waterways.

Increases were reported in all types of traffic with the exception of a 1-million-ton decrease in domestic lakewise traffic. New record totals were recorded in the coastwise and internal domestic trades and in foreign imports. Total domestic traffic advanced to almost 771 million tons, and foreign trade closed the year with over 358 million tons.

In the domestic trades, coastwise traffic amounted to 215 million tons, a gain of 8 million tons from 1961 and 6 million tons greater than the previous high in 1960; almost two-thirds of this trade is carried by private carriers. Internal traffic increased 7.5 percent to 316 million tons, continuing an upward trend from the close of World War II that was interrupted only in the recession years of 1949, 1954, and 1958. Local and intraport traffic, although not reaching record proportions, gained 8.5 percent over the previous year to reach 102 million tons. Intraterritory also showed a significant increase of 14.3 percent.

After 2 years of decline in 1960 and 1961, imports from foreign countries resumed its prior, continuous upward trend and established a new record of 223 million tons, 23 million tons higher than last year and 9 million tons more than the previous record of 214 million tons in 1959. Exports were also greater than 1961, with a total of 136 million tons for a gain of 5.2 percent; however, the 1962 total is substantially below the 172 million tons in 1957. Total increase in foreign trade amounted to 29 million tons, with 6 million tons being accounted for by U.S. ports on the Great Lakes. Direct

overseas traffic of U.S. Great Lakes ports advanced from 5.4 million tons to 6.1 million tons, a gain of 13.2 percent.

All systems contributed to the increase in ton-miles. On the Great Lakes system, the increase in foreign trade tonnage overbalanced the loss in the domestic trade and resulted in an overall increase of 3 billion ton-miles and a total of 90 billion on this system. The Mississippi River system showed the greatest improvement, advancing from 72 billion in 1961 to 79 billion in 1962. Each of the coastal systems was higher than last year and collectively registered a total of 54 billion ton-miles after hovering around the 51 billion mark in each of the three previous years.

Total freight handled at ports and carried on the waterways improved by the Corps of Engineers under congressional authorization are presented in the following tabulations. Detailed data on the commodities handled and the vessel trips at individual ports and waterways are contained in the publications listed in paragraph B2, section 9, chapter VI.

TOTAL WATERBORNE COMMERCE OF THE UNITED STATES
1952-1962

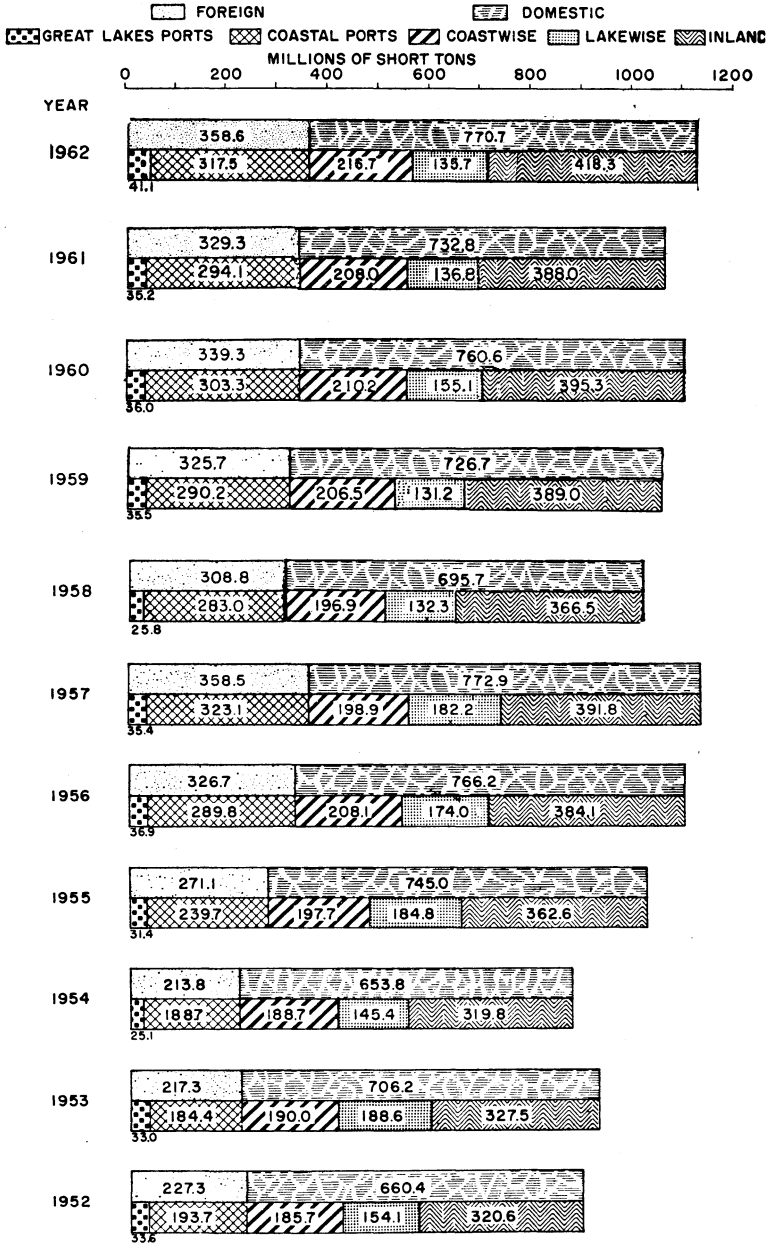

CHART VI

TON-MILES OF FREIGHT CARRIED ON THE WATERWAYS OF THE UNITED STATES, 1952-1962

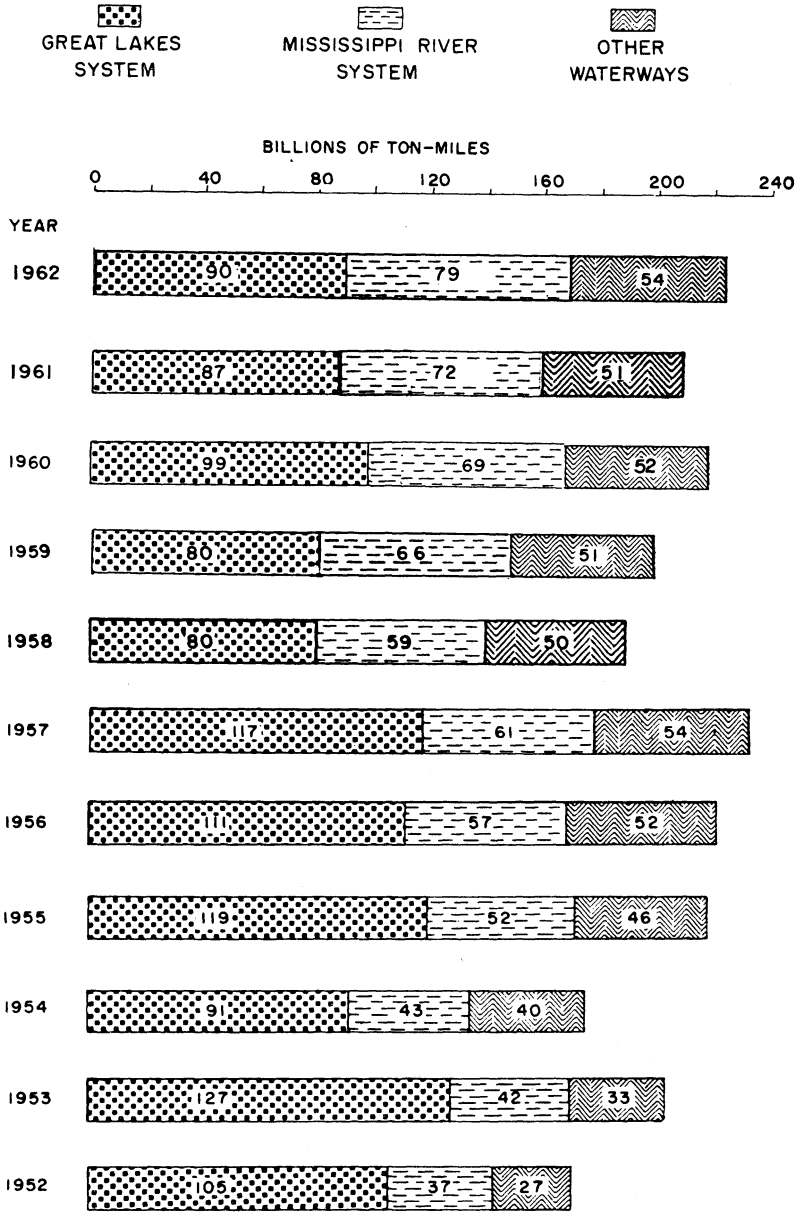

CHART VII

APPENDIX A

GENERAL

A–1 Reservoirs of the Corps of Engineers.

Exhibit A–1. Reservoirs of the Corps of Engineers as of June 30, 1963

(Storage in thousands of acre-feet. Total storage is shown)[1]

Region	Completed or in partial operation		Under construction not operable		Authorized, not started		Total active		Deferred	Inactive	Total of active, deferred, inactive
	Number	Storage	Number	Storage	Number	Storage	Number	Storage	Number	Number	Number
Alaska	------	-------	------	-------	2	570	2	570	------	------	2
Arkansas-White-Red	30	36, 176	15	15, 088	21	5, 599	66	56, 863	5	4	75
Arkansas	17	9, 268	9	8, 363	11	2, 571	37	20, 202	1	1	39
White	5	14, 110	1	1, 952	------	-------	6	16, 062	2	1	9
Red	8	12, 798	5	4, 773	10	3, 028	23	20, 599	2	2	27
Central and South Pacific	11	489	------	-------	1	277	12	766	------	5	17
Central Valley	[2] 13	[2] 3, 330	3	4, 280	8	5, 519	24	13, 129	1	------	25
Colorado	5	2, 561	1	805	2	284	8	3, 650	------	------	8
Columbia	16	6, 112	9	7, 959	8	6, 818	[3] 33	[3] 20, 889	1	------	34
Great Basin	------	-------	------	-------	4	65	4	65	3	------	7
Great Lakes and St. Lawrence	6	452	------	-------	------	-------	6	452	------	1	7
Gulf and South Atlantic	[4] 6	[4] 10, 275	3	1, 020	3	913	12	12, 208	16	------	28
Hawaii	------	-------	------	-------	------	-------	------	-------	------	------	-------
Lower Mississippi	5	4, 717	------	-------	------	-------	5	4, 717	------	------	5
Middle Atlantic	13	3, 521	1	124	17	2, 507	31	6, 152	3	------	34
Missouri	17	78, 820	8	6, 276	16	7, 247	41	92, 343	3	6	50
New England	24	1, 007	5	68	6	123	35	1, 198	3	10	48
North Pacific	2	212	------	-------	4	914	6	1, 126	------	------	6

Ohio	45	16, 503	17	8, 185	23	3, 325	85	28, 013	13	9	107
Rio Grande and Gulf	16	7, 609	6	6, 792	10	2, 031	32	16, 432	1	5	38
Souris and Red	5	1, 269	------	--------	------	--------	5	1, 269	------	2	7
Upper Mississippi	11	2, 829	4	3, 608	5	2, 554	20	8, 991	5	------	25
Total	225	175, 882	72	54, 205	130	38, 746	427	268, 833	54	42	523

[1] Navigation pools (locks and dams) that produce hydroelectric power are included.

[2] Excludes 3 debris-control structures with 89,000 acre-feet of storage.

[3] Four reregulating structures, with 98,000 acre-feet of storage, are included as separate reservoirs.

[4] The Central and Southern Florida project, consisting of some 21 lakes and conservation impoundments with 10,690,000 acre-feet of storage, is not included in the region total.

Appendix B

NAVIGATION

Exhibit B–1. Total Waterborne Commerce of the United States, Calendar Years 1952–62

(In millions of tons of 2,000 pounds)

Year	Total	Foreign						Domestic						
		Imports			Exports			Total	Coastwise	Lakewise	Internal	Intraport	Local	Intraterritory
		Total	Coastal ports	Great Lakes ports	Total	Coastal ports	Great Lakes ports							
1952	887.7	116.0	108.7	7.3	111.4	85.1	26.3	660.4	184.2	154.1	216.6	49.2	54.8	1.5
1953	923.5	128.0	120.6	7.4	89.4	63.8	25.6	706.2	188.8	188.6	225.0	47.9	54.7	1.3
1954	867.6	129.4	123.5	5.9	84.4	65.2	19.2	653.8	187.2	145.4	217.1	48.0	54.7	1.4
1955	1,016.1	153.0	144.3	8.7	118.1	95.4	22.7	745.0	195.7	184.8	249.7	52.9	60.0	2.0
1956	1,092.9	174.2	163.3	10.9	152.5	126.5	26.0	766.2	205.9	174.0	269.7	53.1	61.3	2.2
1957	1,131.4	186.4	176.2	10.1	172.2	146.9	25.3	772.9	196.4	182.2	281.1	50.2	60.6	2.4
1958	1,004.5	189.5	181.5	8.0	119.4	101.6	17.8	695.7	194.1	132.3	261.1	48.9	56.5	2.8
1959	1,052.4	213.5	198.6	14.9	112.2	91.6	20.6	726.7	205.5	131.2	282.3	49.7	57.1	[1] 1.0
1960	1,099.9	211.3	198.5	12.9	128.0	104.8	23.2	760.6	209.2	155.1	291.1	49.5	54.7	1.0
1961	1,062.2	200.2	188.2	12.0	129.2	106.0	23.2	732.8	206.9	136.8	294.1	43.2	50.7	1.1
1962	1,129.4	222.7	207.0	15.7	135.9	110.5	25.4	770.8	215.5	135.7	316.1	47.9	54.4	1.3

[1] Traffic within the States of Alaska and Hawaii transferred to other domestic traffic categories.

Note. Totals represent the sums of unrounded figures, hence they may vary slightly from the sums of the rounded amounts.

Exhibit B–2. Commerce at Project Harbors, Calendar Year 1962

(In tons of 2,000 pounds)

Harbor	Tons
ALABAMA	
Dauphin Island Bay	288
Fly Creek (Fairhope)	413
Guntersville	1, 556, 141
Mobile Harbor	15, 844, 830
ALASKA	
Anchorage	351, 963
Cordova Harbor	43, 459
Craig Harbor	1, 855
Dillingham Harbor	15, 368
Elfin Cove	119
Homer	54, 072
Iliuliuk Harbor (Dutch Harbor)	155, 093
Juneau Harbor	124, 277
Ketchikan Harbor	1, 040, 147
Kodiak Harbor	80, 267
Metlakatla Harbor	11, 744
Nome Harbor	42, 224
Pelican Harbor	5, 377
Petersburg Harbor	59, 085
Port Alexander Harbor	200
Seldovia Harbor	60, 151
Seward Harbor	670, 037
Sitka Harbor	681, 356
Skagway Harbor	169, 767
Valdez Harbor	41, 620
Whittier Harbor	132, 427
Wrangell Harbor	178, 220
ARKANSAS	
Helena	1, 802, 162
CALIFORNIA	
Bodega Bay	861
Crescent City Harbor	399, 093
Halfmoon Bay	190
Humboldt Harbor and Bay	583, 127
Long Beach Harbor	9, 468, 393
Los Angeles Harbor	22, 239, 534
Monterey Harbor	133, 550
Morro Bay Harbor	3, 221
Moss Landing Harbor	220, 438
Newport Bay Harbor	3, 538
Oakland Harbor	4, 001, 472
Redondo Beach (King Harbor)	45
Redwood City Harbor	3, 192, 028
Richmond Harbor	17, 694, 795
San Diego Harbor	2, 266, 986
San Francisco Harbor	4, 278, 454
Santa Barbara Harbor	1, 534
Stockton	3, 064, 491
CONNECTICUT	
Branford Harbor [1]	----------
Bridgeport Harbor	2, 518, 424
Clinton Harbor	207
Duck Island Harbor [1]	----------
Fivemile River Harbor	924
Greenwich Harbor	81, 268
Guilford Harbor	3, 353
Milford Harbor	917
New Haven Harbor	8, 340, 016
New London Harbor	1, 229, 368
Norwalk Harbor	719, 662
Southport Harbor [1]	----------
Stamford Harbor	790, 862
Stonington Harbor	1, 052
Westport Harbor and Saugatuck River	13, 054
DELAWARE	
Wilmington Harbor	2, 362, 672
DISTRICT OF COLUMBIA	
Washington Harbor	3, 030, 140

See footnote at end of table.

Exhibit B–2. Commerce at Project Harbors, Calendar Year 1962—Continued

(In tons of 2,000 pounds)

Harbor	Tons
FLORIDA	
Apalachicola Bay	20, 064
Canaveral Harbor	346, 111
Carrabelle Harbor	48, 427
Cedar Keys Harbor	933
Charlotte Harbor	1, 642, 968
Eau Gallie Harbor	105
Everglades Harbor, Collier County	4, 691
Fernandina Harbor	178, 383
Fort Myers Beach	26, 044
Fort Pierce Harbor	76, 991
Horseshoe Cove	232
Jacksonville Harbor	8, 671, 216
Key West Harbor	324, 126
Melbourne Harbor	102
Miami Harbor	1, 181, 345
Palm Beach Harbor	506, 545
Panama City Harbor	1, 123, 472
Pensacola Harbor	651, 910
Port Everglades Harbor	5, 244, 298
Port St. Joe Harbor	1, 743, 690
St. Augustine Harbor	7, 236
St. Petersburg Harbor	419, 358
Tampa Harbor	15, 427, 164
GEORGIA	
Brunswick Harbor	720, 724
Darien Harbor	732
Savannah Harbor	4, 558, 411
HAWAII	
Hilo Harbor, Hawaii	835, 165
Honolulu Harbor, Oahu	4, 295, 155
Kahului Harbor, Maui	714, 631
Kaunakakai Harbor, Molokai	322, 721
Kawaihae Harbor, Hawaii	126, 102
Nawiliwili Harbor, Kauai	410, 518
Port Allen Harbor, Kauai	155, 369
ILLINOIS	
Calumet Harbor and River	19, 888, 545
Chicago Harbor	516, 159
Port of Chicago	39, 146, 795
Waukegan Harbor	316, 833
INDIANA	
Calumet Harbor and River	19, 888, 545
Indiana Harbor	18, 218, 337
Michigan City Harbor	128, 819
Mount Vernon	4, 670, 067
KENTUCKY	
Louisville	7, 706, 210
LOUISIANA	
Baton Rouge	31, 095, 502
Lake Charles (Calcasieu River and Pass)	17, 495, 785
New Orleans	71, 569, 913
MAINE	
Bar Harbor	2, 202
Belfast Harbor	2, 154
Boothbay Harbor	5, 154
Camden Harbor	575
Cape Porpoise Harbor	26, 463
Corea Harbor	239
Eastport Harbor	36, 815
Hendricks Harbor	1, 456
Isle au Haut Thoroughfare	2, 580
New Harbor	559
Northeast Harbor	46
Portland Harbor	15, 467, 817
Rockland Harbor	111, 827
Rockport Harbor [1]	----------
South Bristol Harbor	245
Southwest Harbor	4, 324

See footnote at end of table.

Exhibit B–2. Commerce at Project Harbors, Calendar Year 1962—Continued

(In tons of 2,000 pounds)

Harbor	Tons
MAINE—Continued	
Stonington Harbor	14, 612
Thomaston Harbor [1]	----------
Wood Island Harbor and the pool at Biddeford	214
York Harbor	490
MARYLAND	
Annapolis Harbor	17, 876
Baltimore Harbor and Channels	42, 587, 893
Black Walnut Harbor	477
Breton Bay	17, 854
Cambridge Harbor	102, 578
Claiborne Harbor	4, 489
Crisfield Harbor	58, 060
Lowes wharf, Talbot County	2, 701
Nanticoke River at Bivalve	1, 892
Nanticoke River at Nanticoke	3, 580
Ocean City Harbor and Inlet and Sinepuxent Bay	4, 286
Queenstown Harbor	302
Rock Hall Harbor	6, 150
Tilghman Island Harbor	5, 604
MASSACHUSETTS	
Beverly Harbor	156, 792
Boston, Main Waterfront	5, 369, 124
Chatham (Stage) Harbor [1]	----------
Cohasset Harbor	230
Cotuit Harbor [1]	----------
Cuttyhunk Harbor	292
Duxbury Harbor	108
Edgartown Harbor	3, 635
Fall River Harbor	2, 599, 329
Falmouth Harbor [1]	----------
Gloucester Harbor	176, 019
Harbor of Refuge, Nantucket	35, 587
Hingham Harbor	4
MASSACHUSETTS—Con.	
Hyannis Harbor	5
Lynn Harbor	3, 937
Manchester Harbor	356
Marblehead Harbor	592
New Bedford and Fairhaven Harbor	300, 549
Newburyport Harbor	621
Plymouth Harbor (including North Plymouth)	11, 098
Pollock Rip Shoals, Nantucket Sound [1]	----------
Port of Boston	18, 984, 380
Provincetown Harbor	9, 821
Rockport Harbor	555
Salem Harbor	1, 699, 602
Scituate Harbor	442
Vineyard Haven Harbor	57, 627
Wareham Harbor [1]	----------
Wellfleet Harbor	759
MICHIGAN	
Algonac	11, 369
Alpena Harbor	2, 361, 655
Au Sable Harbor and River (Oscoda)	260
Big Bay Harbor	3
Black River Harbor	19
Caseville Harbor [1]	----------
Cedar River Harbor	651
Charlevoix Harbor	103, 121
Cheboygan Harbor	106, 753
Chippewa Harbor (Isle Royale) [1]	----------
Detour	247, 281
Drummond Island	1, 427, 077
Eagle Harbor [1]	----------
Frankfort Harbor	1, 174, 769
Gladstone Harbor	283, 936
Grand Haven Harbor and Grand River	2, 790, 801
Grand Marais Harbor (Harbor of Refuge)	37

See footnote at end of table.

Exhibit B–2. Commerce at Project Harbors, Calendar Year 1962—Continued

(In tons of 2,000 pounds)

Harbor	Tons	Harbor	Tons
MICHIGAN—Con.		MINNESOTA	
Grand Traverse Bay Harbor	718	Beaver Bay Harbor	32
Harbor Beach, Harbor of Refuge	40, 758	Duluth-Superior Harbor	30, 298, 381
Harrisville Harbor	110, 963	Grand Marais Harbor	55, 776
Holland Harbor	236, 277	Knife River Harbor	141
Lac La Belle Harbor	122	Lutsen Harbor	12
Leland Harbor	562	Minneapolis	569, 610
Lime Island	164, 110	St. Paul	3, 910, 305
Ludington Harbor	3, 686, 435	Two Harbors (Agate Bay)	13, 016, 158
Mackinac Harbor	13, 032	Warroad Harbor	1, 616
Manistee Harbor	502, 637	MISSISSIPPI	
Manistique Harbor	136, 134	Biloxi Harbor	162, 409
Marine City	76, 033	Greenville	1, 198, 891
Marquette Harbor	1, 063, 449	Gulfport Harbor	321, 834
Marysville	139, 185	Natchez	656, 180
Menominee Harbor and River	579, 062	Pascagoula Harbor	2, 350, 080
Monroe Harbor	23, 414	Pass Christian Harbor	1, 104
Muskegon Harbor	3, 358, 739	Vicksburg	1, 138, 073
Ontonogan Harbor	16, 231	MISSOURI	
Pentwater Harbor	61		
Pine River [1]	----------	Kansas City	1, 878, 769
Port Huron	905, 336	St. Louis	9, 791, 897
Port of Detroit	27, 023, 384	NEW HAMPSHIRE	
Port Sanilac Harbor	86		
Presque Isle Harbor	3, 980, 772	Portsmouth Harbor	1, 454, 768
Rogers City Harbor	84	Rye Harbor	87
St. Clair	3, 266, 152	NEW JERSEY	
St. James Harbor (Beaver Island)	2, 028		
St. Joseph Harbor	382, 739	Keyport Harbor [1]	----------
Saugatuck Harbor and Kalamazoo River	708	NEW YORK	
Sault Ste. Marie	437, 997		
Sebewaing	46	Barcelona	41
South Haven Harbor	192, 451	Cape Vincent Harbor [1]	----------
Traverse City Harbor	173, 309	Dunkirk Harbor	28, 308
White Lake Harbor	32, 497	Echo Bay Harbor	97, 808
Whitefish Point Harbor	183		

See footnote at end of table.

Exhibit B–2. Commerce at Project Harbors, Calendar Year 1962—Continued

(In tons of 2,000 pounds)

Harbor	Tons
NEW YORK—Con.	
Great Kills Harbor, Staten Island [1]	----------
Great Sodus Bay Harbor	1, 531, 319
Greenport Harbor	20, 760
Hay (West) Harbor	1, 229
Hempstead Harbor	5, 591, 657
Huntington Harbor	629, 117
Lake Montauk Harbor	2, 127
Mamaroneck Harbor	78, 977
Mattituck Harbor	46, 924
Milton Harbor	21, 584
Morristown Harbor [1]	----------
New Rochelle Harbor	3, 930
Niagara Falls	23, 450
Northport Harbor	19, 905
Ogdensburg Harbor	327, 560
Olcott Harbor [1]	----------
Oswego Harbor	1, 026, 101
Peekskill Harbor	166, 379
Plattsburg Harbor [1]	----------
Port Chester Harbor	457, 793
Port Henry Harbor	10, 973
Port Jefferson Harbor	1, 703, 927
Port of Albany	6, 782, 109
Port of Buffalo	15, 587, 245
Port of New York	154,476,480
Rochester (Charlotte) Harbor	319, 942
Rondout Harbor	528, 037
Sackets Harbor	54, 162
Sag Harbor	27, 732
Saugerties Harbor [1]	----------
Tarrytown Harbor	403, 925
Tonawanda Harbor	616, 943
Waddington Harbor	10, 315
Wilson Harbor	1
NORTH CAROLINA	
Beaufort Harbor	60, 202
Belhaven Harbor	12, 889
Edenton Harbor	48, 376
Manteo (Shallowbag) Bay	53, 708
Morehead City Harbor	540, 416
Port of Wilmington (see also Wilmington Harbor, N.C., for waterway data)	4, 820, 199
Silver Lake Harbor	9, 497
OHIO	
Ashtabula Harbor	9, 050, 978
Cincinnati	6, 727, 637
Cleveland Harbor	16, 899, 750
Conneaut Harbor	3, 063, 238
Fairport Harbor	3, 050, 751
Huron Harbor	1, 546, 196
Lorain Harbor	5, 799, 726
Port Clinton Harbor	20, 253
Put-In-Bay Harbor	5, 684
Sandusky Harbor	4, 154, 225
Toledo Harbor	36, 535, 893
Vermilion Harbor	602
OREGON	
Astoria	922, 673
Coos Bay, inside channel bar to Millington	3, 140, 252
Depoe Bay	234
Oregon Slough (North Portland Harbor)	322, 227
Port of Portland	13, 775, 992
St. Helens	385, 497
Yaquina Bay and Harbor	292, 813
PENNSYLVANIA	
Aliquippa-Rochester	5, 688, 345
Clairton-Elizabeth	8, 098, 637
Erie Harbor	2, 549, 891
Philadelphia Harbor	49, 124, 253
Pittsburgh	6, 922, 302

See footnote at end of table.

Exhibit B–2. Commerce at Project Harbors, Calendar Year 1962—Continued

(In tons of 2,000 pounds)

Harbor	Tons
RHODE ISLAND	
Great Salt Pond, Block Island	668
Harbor of Refuge, Block Island	1,370
Harbor of Refuge, Point Judith and Point Judith Pond	33,893
Newport Harbor	92,492
Providence River and Harbor	8,534,154
Wickford Harbor	11,870
SOUTH CAROLINA	
Charleston Harbor	5,055,512
Georgetown Harbor (Winyah Bay)	962,563
Port Royal Harbor	28,493
TENNESSEE	
Chattanooga	1,935,824
Knoxville	757,436
Memphis	6,903,281
Nashville	2,884,348
TEXAS	
Aransas Pass	108,486
Beaumont	28,141,365
Brazos Island Harbor	4,695,631
Corpus Christi	18,118,523
Freeport Harbor	4,313,016
Galveston (Galveston Channel)	4,220,634
Harbor Island	8,114,590
Houston (Houston Ship Channel)	58,604,886
Orange	1,232,400
Palacios	219,536
Port Arthur	25,685,151
Port Bolivar	6,187
Port Lavaca	2,079,512
Port Mansfield	53,332
Rockport	445
Sabine Pass Harbor	172,260
Texas City (Texas City Channel)	18,576,203
Victoria	419,754
VERMONT	
Burlington Harbor	460,427
VIRGINIA	
Cape Charles City Harbor	48,429
Horn Harbor	6,693
Monroe Bay and Creek	4,079
Norfolk Harbor	41,508,366
Port of Newport News	11,996,353
Port of Richmond	3,378,741
Portsmouth Harbor, channel to Nansemond Ordnance Depot [1]	----------
Potomac River at Alexandria	373,189
Winter Harbor	1,561
WASHINGTON	
Anacortes Harbor	6,382,297
Bellingham Bay and Harbor	1,629,513
Blaine Harbor	18,808
Everett Harbor	2,622,586
Grays Harbor and Chehalis River	2,014,771
Hammersley Inlet (Shelton Harbor)	670,535
Longview	2,946,330
Neah Bay	221,787
Olympia Harbor	842,888
Port Angeles Harbor	2,110,005
Port Gamble Harbor	251,331

See footnote at end of table.

Exhibit B–2. Commerce at Project Harbors, Calendar Year 1962—Continued

(In tons of 2,000 pounds)

Harbor	Tons	Harbor	Tons
WASHINGTON—Con.		WISCONSIN—Con.	
Port Townsend Harbor	809,076	Port Washington Harbor	495,882
Seattle Harbor	13,933,935	Port Wing Harbor	310
Tacoma Harbor	5,429,147	Racine Harbor	131,024
Vancouver	1,700,873	Saxon Harbor [1]	----------
Willapa River and Harbor, and Naselle River	457,922	Sheboygan Harbor	499,117
		Two Rivers Harbor	163,737
WEST VIRGINIA		PUERTO RICO	
Huntington	14,005,157	Arecibo Harbor [1]	----------
		Fajardo Harbor	43,626
WISCONSIN		Guayanes Harbor	9,449
		Mayaguez Harbor	217,754
Algoma Harbor	419	Ponce Harbor	724,384
Ashland Harbor	1,501,943	San Juan Harbor	5,646,711
Bayfield Harbor	1,404		
Big Suamico River	332	VIRGIN ISLANDS	
Cornucopia Harbor	250		
Detroit Harbor	6,974	Christiansted Harbor, St. Croix	26,076
Duluth-Superior Harbor	30,298,381	St. Thomas Harbor	346,291
Green Bay Harbor	2,493,948		
Jackson Harbor [1]	----------		
Kenosha Harbor	81,028	MIDWAY ISLAND	
Kewaunee Harbor	1,024,524		
Manitowoc Harbor	1,940,332	Welles Harbor	11,248
Menominee Harbor and River	579,062	WAKE ISLAND	
Milwaukee Harbor	6,724,912		
Onconto Harbor	56	Wake Island Harbor	171,550
Pensaukee Harbor	158		

[1] No commerce reported.

Exhibit B–3. Commerce at Selected Areas, Calendar Year 1962

(In tons of 2,000 pounds)

Area	Tons
Delaware River and tributaries, Trenton, N.J., to the sea:	
Burlington-Florence-Roebling, N.J	1, 004, 454
Camden-Gloucester, N.J	4, 099, 024
Chester, Pa	880, 517
Marcus Hook, Pa., and vicinity	17, 942, 196
New Castle, Del., and vicinity	12, 554, 835
Paulsboro, N.J., and vicinity	16, 538, 664
Penn Manor, Pa., and vicinity	8, 285, 320
Philadelphia Harbor, Pa	49, 124, 253
Riverton-Delanco-Beverly, N.J	618, 258
Trenton Harbor, N.J	3, 303, 641
Wilmington Harbor, Del	2, 362, 672
Other	1, 423, 493
Gross total	118, 137, 327
Net total	104, 501, 518
Hampton Roads, Va.:	
Channel from Phoebus, Va., to deepwater in Hampton Roads	2, 828
Hampton Creek, Va	297, 368
Norfolk Harbor, Va	41, 508, 366
Port of Newport News, Va	11, 996, 353
Other	----------
Gross total	53, 804, 915
Net total	53, 353, 311
Corpus Christi Bay, Tex.:	
Corpus Christi, Tex	18, 118, 523
Harbor Island, Tex	8, 114, 590
Gross total	26, 233, 113
Net total	26, 188, 418

Exhibit B–3. Commerce at Selected Areas, Calendar Year 1962—Continued

(In tons of 2,000 pounds)

Area	Tons
San Francisco Bay, Calif.:	
Carquinez Straight, Calif	10, 085, 428
Oakland Harbor, Calif	4, 001, 472
Redwood City Harbor, Calif	3, 192, 028
Richmond Harbor, Calif	17, 694, 795
Sacramento River, Calif	1, 961, 994
San Francisco Harbor, Calif	4, 278, 454
San Joaquin River and tributaries, Calif	4, 046, 279
San Pablo Bay and Mare Island Strait, Calif	2, 249, 591
Suisun Bay Channel, Calif	4, 658, 069
Other	3, 055, 746
Gross total	55, 223, 856
Net total	44, 642, 357
Chicago, Ill. and Ind.:	
Buffington Harbor, Ind	1, 386, 456
Calumet Harbor and River, Ill. and Ind	19, 888, 545
Chicago Harbor, Ill	516, 159
Gary Harbor, Ind	9, 045, 039
Indiana Harbor, Ind	18, 218, 337
Lake Calumet, Ill	832, 378
Other	19, 983, 318
Gross total	69, 870, 232
Net total	66, 203, 119

Exhibit B–4. Ton-Mileage of Freight Carried on the Inland Waterways of the United States, by System, Calendar Year 1962

System	Ton-miles
Atlantic coast waterways	29, 404, 593, 000
Gulf coast waterways	17, 937, 896, 000
Pacific coast waterways	6, 362, 795, 000
Mississippi River system, including Ohio River and tributaries	79, 304, 958, 000
Other waterways	29, 410, 000
Great Lakes system [1]	90, 049, 452, 000
Total	223, 089, 104, 000

[1] Does not include traffic between foreign ports.

Exhibit B–5. Commerce on Project Waterways, Calendar Year 1962

(In tons of 2,000 pounds)

Waterway	Tons	Total ton miles (000 omitted)
ATLANTIC COAST		
Abbapoola Creek, S.C.[2]		
Aberdeen Creek, Va	15, 988	16
Absecon Creek, N.J	115	(1)
Absecon Inlet, N.J	101, 824	204
Alloway Creek, N.J.[2]		
Altamaha River, Ga	28, 603	172
Anacostia River, D.C	1, 948, 535	3, 897
Annisquam River, Mass	2	(1)
Appomattox River, Va.[2]		
Appoquinimink River, Del.[2]		
Aquia Creek, Va.[2]		
Ashley River, S.C	2, 592	16
Atlantic Intracoastal Waterway between Norfolk, Va., and the St. Johns River, Fla. (net)	3, 018, 792	700, 317
U.S. Army Engineer District, Norfolk:		
Via Dismal Swamp Canal Route	51, 167	1, 334
Via Great Bridge Lock Route	1, 020, 505	34, 453
U.S. Army Engineer District, Wilmington	2, 063, 646	374, 510
U.S. Army Engineer District, Charleston	1, 485, 060	193, 058
U.S. Army Engineer District, Savannah	1, 139, 430	108, 348
U.S. Army Engineer District, Jacksonville	881, 602	17, 211
Back Creek (Anne Arundel County), Md	860	(1)
Bakers Haulover Inlet, Fla	560	(1)
Barnegat Inlet, N.J	1, 376	1
Bay Ridge and Red Hook Channels, N.Y	10, 880, 852	43, 523
Bay River, N.C	970	12
Beresford Creek, S.C	65, 250	117
Big Timber Creek, N.J	281, 096	84
Black River, N.C.[2]		
Blackwater River, Va	80, 738	1, 090
Bransons Cove, Va	993	(1)
Breton Bay, Md	17, 854	112
Broad Creek, Va	343	(1)
Broad Creek River, Del	6, 615	66
Broad Creek, Somerset County, Md	484	2
Broadkill River, Del	305	1
Broadwater Creek, Md.[2]		
Bronx River, N.Y	675, 472	1, 013
Browns Creek, N.Y	5, 000	6
Buttermilk Channel, N.Y	2, 291, 513	5, 270
Cadle Creek, Md.[2]		
Cape Cod Canal, Mass	10, 927, 003	191, 223
Cape Fear River above Wilmington, N.C	427, 770	32, 211

See footnotes at end of table.

Exhibit B–5. Commmerce on Project Waterways, Calendar Year 1962—Continued

(In tons of 2,000 pounds)

Waterway	Tons	Total ton miles (000 omitted)
ATLANTIC COAST—Continued		
Cape May Canal, N.J	160	1
Carter Creek, Va	21, 249	28
Cashie River, N.C	14, 375	295
Channel between Staten Island and Hoffman and Swinburne Islands, N.Y.[2]		
Channel connecting Thoroughfare Bay with Cedar Bay, N.C	717	3
Channel connecting York River, Va., with Back Creek to Slaight's Wharf	2, 565	3
Channel from Back Sound to Lookout Bight, N.C	83	(1)
Channel from Pamlico Sound to Avon, N.C	10, 238	10
Channel from Pamlico Sound to Rodanthe, N.C	90	(1)
Channel from Phoebus, Va, to deep water in Hampton Roads	2, 828	2
Channel to Island Creek, St. George Island, Md	507	(1)
Channel to Newport News, Va	17, 544, 606	57, 020
Cheesequake Creek, N.J.[2]		
Chelsea River, Mass	6, 561, 258	9, 842
Chester River, Md	62, 524	1, 592
Chester River, Pa.[2]		
Chincoteague Bay, Md. and Va	4, 381	13
Choptank River, Md	29, 108	2, 841
Chowan River, N.C	119, 485	4, 527
Coan River, Va	8, 361	17
Cockrell Creek, Va	108, 033	162
Cohansey River, N.J	104, 105	1, 978
Cold Spring Inlet, N.J	107, 990	108
Coney Island Channel, N.Y	5, 866, 435	7, 626
Coney Island Creek, N.Y	508, 963	521
Congaree River, S.C.[2]		
Connecticut River above Hartford, Conn.[2]		
Connecticut River below Hartford, Conn	3, 009, 199	138, 423
Contentnea Creek, N.C.[2]		
Cooper River, N.J	110, 633	111
Corsica River, Md	1	(1)
Courtenay Channel, Fla.[2]		
Cranes Creek, Va	361	(1)
Davis Creek, Va	7, 865	4
Deep Creek, Accomac County, Va	402	(1)
Deep Creek, Newport News, Va	15, 977	32

See footnotes at end of table.

Exhibit B–5. Commerce on Project Waterways, Calendar Year 1962—Continued

(In tons of 2,000 pounds)

Waterway	Tons	Total ton miles (000 omitted)
ATLANTIC COAST—Continued		
Delaware River:		
Trenton, N.J., to the sea (net)	105, 700, 697	8, 863, 538
At Camden, N.J	1, 977, 768	(4)
Between Philadelphia, Pa., and Trenton, N.J	17, 244, 231	241, 419
Harbor of Refuge, Delaware Bay, Del	144, 385	217
Philadelphia, Pa., to the sea	103, 880, 947	8, 622, 119
Dennis Creek, N.J.[2]		
Dorchester Bay, Mass	58, 607	59
Double Creek, N.J.[2]		
Drum Inlet, N.C	18	(1)
Duck Point Cove, Md	2, 258	2
Dymers Creek, Va	12, 489	12
East Chester Creek, N.Y	1, 945, 990	6, 811
East River, N.Y	52, 914, 174	423, 313
East Rockaway Inlet, N.Y	1, 329, 902	1, 330
Elizabeth River, N.J.[2]		
Elk and Little Elk Rivers, Md	10	(1)
Fancy Bluff Creek, Ga.[2]		
Far Creek, N.C	5, 875	12
Fire Island Inlet, N.Y	288, 719	433
Fishing Bay Tributaries, Dorchester County, Md	5, 425	5
Fishing Creek, Calvert County, Md	35	(1)
Flushing Bay, N.Y	2, 732, 722	8, 745
Fort Point Channel, Mass	180, 266	90
Glen Cove Creek, N.Y	259, 941	260
Goshen Creek, N.J.[2]		
Governors Run, Md	97	(1)
Gowanus Creek Channel, N.Y	4, 898, 252	3, 125
Great Pee Dee River, S.C	26, 613	266
Great South Bay, N.Y	301, 421	5, 218
Hackensack River, N.J	3, 926, 074	35, 335
Hampton Creek, Va	297, 368	833
Harlem River, N.Y	2, 032, 840	5, 667
Hellens Creek, Md.[2]		
Herring Bay and Rockhold Creek, Md	84	(1)
Herring Creek, Md	72	(1)
Honga River and Tar Bay, Md	5, 240	21
Hoskins Creek, Va	8, 799	9
Housatonic River, Conn	962, 101	4, 811

See footnotes at end of table.

Exhibit B–5. Commerce on Project Waterways, Calendar Year 1962—Continued

(In tons of 2,000 pounds)

Waterway	Tons	Total ton miles (000 omitted)
ATLANTIC COAST—Continued		
Hudson River, N.Y. and N.J.:		
Deep Water in Upper Bay, N.Y., to Waterford, N.Y. (net)	39, 156, 028	1, 964, 169
Mouth of Spuyten Duyvil Creek (Harlem River) to Waterford, N.Y	21, 072, 593	1, 560, 126
Hudson River Channel, N.Y. and N.J	36, 068, 414	404, 043
Hull Creek, Va	266	1
Indian River Inlet and Bay, Del.[2]		
Inland Waterway between Rehoboth Bay and Delaware Bay, Del	4, 859	53
Inland Waterway from Delaware River to Chesapeake Bay, Del. and Md.—Chesapeake and Delaware Canal	9, 254, 724	425, 717
Intracoastal Waterway:		
Jacksonville to Miami, Fla	612, 904	34, 365
Miami to Key West, Fla	148, 780	2, 911
Ipswich River, Mass	337	1
Jackson Creek, Va	332	(1)
Jamaica Bay, N.Y	5, 826, 175	69, 914
James River, Va	6, 270, 384	395, 034
Jones Inlet, N.Y	1, 457	3
Josias River, Maine	97	(1)
Kennebec River, Maine	240, 014	3, 733
Kennebunk River, Maine	101	(1)
Kings Creek, Northampton County, Va	2, 468	2
Knapps Narrows, Md	6, 037	7
Knobbs Creek, N.C	6, 721	4
La Trappe River, Md	4, 372	15
Lake Crescent and Dunns Creek, Fla	140	1
Lake Ogleton, Md.[2]		
Leipsic River, Del.[2]		
Lemon Creek, Staten Island, N.Y.[2]		
Little Creek, Queen Annes County, Md	3, 213	1
Little Machipongo River, Va	41, 816	84
Little River, Del	3	(1)
Little River (Creek), Va	60, 516	61
Little Wicomico River, Va	6, 503	13
Locklies Creek, Va	250	(1)
Lockwoods Folly River, N.C	889	2
Long Island Intracoastal Waterway, N.Y	3, 252	111
Lower Entrance Channels, New York Harbor, N.Y	87, 809, 267	878, 093
Lower Machodoc Creek, Va	3, 860	6

See footnotes at end of table.

Exhibit B–5. Commerce on Project Waterways, Calendar Year 1962—Continued

(In tons of 2,000 pounds)

Waterway	Tons	Total ton miles (000 omitted)
ATLANTIC COAST—Continued		
Lower Thoroughfare at or near Wenona, Deal Island, Md	1, 167	1
Lubec Channel, Maine	109, 094	197
Mackay Creek, N.C	147	(1)
Malden River, Mass	699	(1)
Manasquan River, N.J	59, 590	89
Manhasset Bay, N.Y	1, 125, 228	1, 575
Manokin River, Md	247	1
Mantua Creek, N.J	322, 969	323
Matawan Creek, N.J.[2]		
Mattaponi River, Va	37, 472	606
Maurice River, N.J	18, 111	127
Meherrin River, N.C	6, 019	63
Menemsha Creek, Marthas Vineyard, Mass	147	(1)
Merrimack River, Mass.[2]		
Miami River, Fla	265, 219	1, 204
Mianus River and Cos Cob Harbor, Conn	23, 490	23
Middle River and Dark Head Creek, Md	360	1
Milford Haven, Va	2, 601	3
Mill Creek, Md	251	(1)
Mill Creek, Va	76	(1)
Mingo Creek, S.C.[2]		
Mispillion River, Del	12, 516	150
Moriches Inlet, N.Y	182	(1)
Mulberry Creek, Va	1, 958	1
Murderkill River, Del	191	(1)
Mystic River, Conn	12	(1)
Mystic River, Mass	4, 957, 319	4, 866
Nandua Creek, Va	665	3
Nansemond River, Va	560, 563	4, 653
Nanticoke River (including Northwest Fork), Del. and Md	313, 745	12, 352
Narrows of Lake Champlain, N.Y. and Vt	1, 142, 661	15, 426
Neale Sound, Md	392	1
Neponset River, Mass.[2]		
Neuse River, N.C	479, 516	4, 795
New Jersey Intracoastal Waterway	252, 100	1, 513
New River, Fla	450	4
New York and New Jersey Channels, N.Y. and N.J	105, 157, 734	1, 947, 535
New York State Barge Canal System, N.Y	3, 279, 944	409, 495
Newark Bay, N.J	23, 827, 615	96, 081
Newport News Creek, Va	170, 003	68
Newtown Creek, N.Y	8, 410, 627	25, 232

See footnotes at end of table.

Exhibit B–5. Commerce on Project Waterways, Calendar Year 1962—Continued

(In tons of 2,000 pounds)

Waterway	Tons	Total ton miles (000 omitted)
ATLANTIC COAST—Continued		
Nomini Bay and Creek, Va	8,685	26
Northeast (Cape Fear) River, N.C	138,957	3,474
Northeast River, Md	723	4
Occohannock Creek, Va	992	4
Occoquan Creek, Va	10	(1)
Ocmulgee River, Ga.[2]		
Oconee River, Ga.[2]		
Ocracoke Inlet, N.C	1,402	2
Oklawaha River, Fla	250	1
Oldmans Creek, N.J.[2]		
Onancock River, Va	30,635	168
Orowoc Creek, N.Y	2,262	2
Otter Creek, Vt.[2]		
Oyster Channel, Va	20,899	19
Pagan River, Va	14,904	60
Palm Beach, Fla., side channel and basin [2]		
Pamlico and Tar Rivers, N.C	45,266	634
Pamunkey River, Va	10,652	16
Parish Creek, Md	9,060	7
Parrotts Creek, Va	3,081	2
Passaic River, N.J	10,754,068	80,656
Patchogue River, N.Y	286,271	215
Patchogue River, Westbrook, Conn	45	(1)
Patuxent River, Md	115,145	809
Pawcatuck River, R.I. and Conn	2,483	16
Peconic Bay and River, N.Y	1,552	2
Penobscot River, Maine	1,502,167	38,681
Perquimans River, N.C	8,415	93
Pocomoke River, Md	66,468	1,994
Potomac River below Washington, D.C	4,606,890	225,783
Potomac River, Virginia Channel, D.C	1,079,840	5,075
Potomac River, Washington Channel, D.C	102	(1)
Quinby Creek, Va	11,032	8
Raccoon Creek, N.J	3,993	36
Rahway River, N.J	196,549	452
Rancocas River, N.J	229,512	298
Rappahannock River, Va	456,888	33,467
Raritan River, N.J	8,977,731	34,093
Raritan River to Arthur Kill Cutoff Channel, N.J	5,067,301	5,067
Reynolds Channel, N.Y	559,025	559
Rhodes Point to Tylerton, Somerset County, Md	523	1
Rice Creek, Fla	117,859	471
Roanoke River, N.C	404,962	8,290

See footnotes at end of table.

Exhibit B–5. Commerce on Project Waterways, Calendar Year 1962—Continued

(In tons of 2,000 pounds)

Waterway	Tons	Total ton miles (000 omitted)
ATLANTIC COAST—Continued		
Rollinson Channel, N.C	9, 628	29
Rondout Creek, N.Y	528, 037	528
Russell Creek, S.C.[2]		
Saco River, Maine	49	(1)
St. Catherines Sound, Md	2, 268	3
St. Croix River, Maine	21, 925	360
St. Jerome Creek, Md	586	1
St. Johns River, Fla., Jacksonville to Lake Harney	602, 777	33, 759
St. Jones River, Del.[2]		
St. Lucie Inlet, Fla	1, 064	3
St. Marys River, Ga. and Fla	143, 743	862
St. Patricks Creek, Md	1, 786	2
St. Peters Creek, Md	27	(1)
Sakonnet River and Harbor, R.I.[2]		
Salem River, N.J	28, 800	115
Sandy Hook Bay, N.J	117, 637	53
Santee River, S.C	11, 775	906
Satilla River, Ga	49, 627	1, 588
Savannah River below Augusta, Ga	99, 840	19, 569
Scarboro River, Maine	94	(1)
Schuylkill River, Pa	14, 188, 016	56, 752
Scuppernong River, N.C	33, 091	165
Seekonk River, R.I	155, 908	312
Shallotte River, N.C	1, 141	3
Shark River, N.J.[2]		
Sheepshead Bay, N.Y	43, 347	13
Shinnecock Inlet, N.Y	1, 565	3
Shipyard River, S.C	671, 803	672
Shoal Harbor and Compton Creek, N.J	82, 877	21
Shrewsbury River, N.J.[2]		
Slaughter Creek, Md	642	1
Smith Creek, Md	1, 972	3
Smiths Creek (Pamlico County), N.C	1, 286	1
Smiths Creek (Wilmington), N.C	8, 205	8
Smyrna River, Del.[2]		
South River, N.C	560	2
Starlings Creek, Va	75, 195	45
Stumpy Point Bay, N.C	1, 009	2
Susquehanna River above and below Havre de Grace, Md	23, 231	116
Swift Creek, N.C.[2]		
Tangier Channel, Va	2, 237	3

See footnotes at end of table.

Exhibit B–5. Commerce on Project Waterways, Calendar Year 1962—Continued

(In tons of 2,000 pounds)

Waterway	Tons	Total ton miles (000 omitted)
ATLANTIC COAST—Continued		
Taunton River, Mass.[2]		
Thames River, Conn	717, 145	12, 089
Toms River, N.J.[2]		
Totuskey Creek, Va	44, 875	247
Town Creek, Md	834	(1)
Town River, Mass	766, 633	575
Tred Avon River, Md	97, 498	975
Trent River, N.C	53, 902	81
Tuckerton Creek, N.J	487	1
Twitch Cove and Big Thoroughfare River, Md	7, 243	36
Tyaskin Creek, Md	4	(1)
Union River, Maine [2]		
Upper Bay, N.Y. and N.J	108, 098, 384	595, 291
Upper Machodoc Creek, Va	149	(1)
Upper Thoroughfare, Deal Island, Md	7, 975	5
Urbanna Creek, Va	16, 165	8
Waccamaw River, N.C. and S.C	17, 485	726
Wallabout Channel, N.Y	563, 173	113
Wallace Channel, Pamlico Sound, N.C	1, 077	8
Wappinger Creek, N.Y.[2]		
Warren River, R.I	662	(1)
Warwick River, Md	9, 537	14
Washington Canal and South River, N.J	57, 751	116
Waterway connecting Pamlico Sound and Beaufort Harbor, N.C	27, 218	490
Waterway connecting Swan Quarter Bay with Deep Bay, N.C	355	1
Waterway from Indian River Inlet to Rehoboth Bay, Del.[2]		
Waterway on the coast of Virginia	82, 984	563
Waycake Creek, N.J.[2]		
Westchester Creek, N.Y	1, 045, 666	2, 091
Weymouth Back River, Mass	36, 735	18
Weymouth Fore River, Mass	2, 228, 278	12, 556
Whitings Creek, Va	1, 014	1
Wicomico River, Md. (Eastern Shore)	561, 975	16, 564
Willoughby Channel, Va.[2]		
Wilmington Harbor, N.C. (see also Port of Wilmington, N.C., for port data)	5, 485, 057	131, 905
Woodbridge Creek, N.J	18, 098	3
Woodbury Creek, N.J.[2]		
Woods Hole Channel, Mass	43, 343	39
York River, Va	5, 006, 485	115, 149

See footnotes at end of table.

Exhibit B–5. Commerce on Project Waterways, Calendar Year 1962—Continued

(In tons of 2,000 pounds)

Waterway	Tons	Total ton miles (000 omitted)
GULF COAST		
Alabama-Coosa Rivers, Ala. and Ga	993, 824	26, 921
Amite River and Bayou Manchac, La	4, 734	118
Anahuac Channel, Tex	488, 381	2, 442
Anclote River, Fla	911	8
Apalachicola, Chattahoochee, and Flint Rivers, Ga. and Fla	388, 584	35, 838
Atchafalaya River, La., Morgan City to Gulf of Mexico	3, 974, 999	132, 701
Barataria Bay Waterway, La	1, 901, 476	35, 219
Bayous:		
Bastrop, Tex.[2]	----------	----------
Bernard, Miss	18, 745	93
Big Pigeon and Little Pigeon, La	220, 905	3, 093
Bonfouca, La	14, 143	127
Casotte, Miss	401, 201	1, 503
Cedar, Tex	262, 035	1, 218
Chico, Fla	86, 693	106
Chocolate, Tex	570, 950	7, 020
Coden, Ala	4, 406	4
Dickinson, Tex	566, 925	6, 537
Double, Tex	43, 295	162
Dupre, La	37, 532	107
Galere, Miss.[2]	----------	----------
Grosse Tete, La	33, 409	374
Johnsons, La	183, 459	917
La Batre, Ala	12, 237	25
La Grange, Fla	78, 086	315
La Loutre, St. Malo, and Yscloskey, La	2, 064	8
Lacombe, La	46, 212	231
Lafourche, La	2, 629, 495	38, 710
Little Caillou, La	129, 136	2, 757
Petit Anse, Tigre, and Carlin, La	1, 162, 374	9, 699
Plaquemine Brule, La	155, 266	848
Queue de Tortue, La.[2]	----------	----------
Segnette Waterway, La	36, 929	75
Teche, La	665, 771	27, 399
Terrebonne, La	1, 432, 441	12, 719
Vermilion, La	800, 953	15, 286
Watson, Fla	133, 678	161
Black Warrior, Warrior, and Tombigbee Rivers, Ala	6, 167, 681	1, 613, 024
Blackwater River, Fla	41, 342	491
Bluff Creek, Miss	505	4
Brazos Island Harbor, Tex. (Waterway)	4, 695, 631	77, 158
Calcasieu River and Pass, La	17, 495, 785	386, 075

See footnotes at end of table.

Exhibit B–5. Commerce on Project Waterways, Calendar Year 1962—Continued

(In tons of 2,000 pounds)

Waterway	Tons	Total ton miles (000 omitted)
GULF COAST—Continued		
Channel from Naples to Gordon Pass and Big Marco Pass, Fla	4, 084	21
Channel from Pass Cavallo to Port Lavaca, Tex	2, 079, 512	32, 926
Channel to Aransas Pass, Tex	108, 486	303
Channel to Palacios, Tex	219, 536	3, 074
Channel to Port Bolivar, Tex	6, 187	12
Channel to Rockport, Tex	445	1
Chefuncte and Bogue Falia Rivers, La	173, 134	376
Chickasaw Creek, Ala	919, 201	1, 628
Choctawhatchee River, Fla. and Ala.[2]		
Clear Creek, Tex	327, 123	4, 236
Clearwater Pass, Fla.[2]		
Crystal River, Fla	1, 326	12
Cypress Bayou aud Waterway between Jefferson, Tex., and Shreveport, La	119	1
East Pass Channel from the Gulf of Mexico into Choctawhatchee Bay, Fla	504	1
East Pearl River, Miss	66, 997	1, 024
Escambia and Conecuh Rivers, Fla. and Ala., Escambia Bay, Fla	638, 366	13, 396
Franklin Canal, La	1, 357	7
Grand Bayou Pass, La.[2]		
Guadalupe River to Victoria, Tex	419, 754	7, 417
Gulf County Canal, Fla	215, 538	1, 092
Gulf Intracoastal Waterway:		
Between Apalachee Bay, Fla., and the Mexican border	60, 424, 304	8, 756, 988
Morgan City—Port Allen Route	6, 623, 556	382, 428
Homosassa River, Fla	598	4
Hudson River Fla	71	(1)
Inland Waterway from Vermilion Bay to Mermentau River, La	681, 556	8, 424
Innerharbor Navigation Canal, La	5, 889, 451	21, 798
Intracoastal Waterway, Caloosahatchee River to Anclote River, Fla	253, 490	7, 061
Kissimmee River, Fla	325	2
Lake Charles Deep Water Channel, La	21, 025, 990	522, 619
Little Manatee River, Fla	1, 090	4
Manatee River, Fla	28, 428	213
Mermentau River, Bayou Nezpique and Bayou Des Cannes, La	3, 036, 506	84, 174
Okeechobee Waterway, Fla	351, 947	12, 962
Ozona, Fla., channel and turning basin [2]		

See footnotes at end of table.

Exhibit B–5. Commerce on Project Waterways, Calendar Year 1962—Continued

(In tons of 2,000 pounds)

Waterway	Tons	Total ton miles (000 omitted)
GULF COAST—Continued		
Pascagoula River, Miss.[2]		
Pass Manchac, La	376, 718	2, 637
Pearl River, Miss. and La	339, 725	11, 391
Pithlachascotee River, Fla	330	1
Port Aransas (Aransas Pass)—Corpus Christi Waterway, Tex	26, 188, 418	432, 869
Port Mansfield, Tex. (tributary)	53, 332	331
Sabine-Neches Waterway, Tex	68, 508, 825	1, 591, 920
St. Marks River, Fla	493, 070	5, 332
San Bernard River, Tex	921, 503	22, 355
Steinhatchee River, Fla	587	3
Suwannee River, Fla	572	4
Terrebonne Bay, La.[2]		
Three Mile Creek, Ala	3, 197, 675	1, 330
Tickfaw, Natalbany, Ponchatoula, and Blood Rivers, La	2, 865	17
Tributary Arroyo Colorado, Tex	221, 600	5, 464
Trinity River, Channel to Liberty, Tex	365, 563	3, 947
Upper Chipola River, Fla., from mouth to Marianna[2]		
Vinton Waterway, La	48, 434	484
Waterway connecting the Tombigbee and Tennessee Rivers, Ala. and Miss.[2]		
Waterway from Empire, La., to Gulf of Mexico	1, 183, 185	10, 571
Waterway from Intracoastal Waterway to Bayou Dulac, La. (Bayous Le Carpe and Grand Caillou)	333, 616	4, 576
Waterway from White Lake to Pecan Island, La	16, 283	33
Watson Bayou, Fla	133, 678	161
Withlacoochee River, Fla	59, 890	549
Wolf and Jordan Rivers, Miss	43, 870	516
PACIFIC COAST		
Chetco River, Oreg	30, 994	9
Chinook Channel, Wash	127	(1)
Clatskanie River, Oreg	86, 444	303
Columbia River:		
Mouth to International Boundary (net)	21, 390, 674	1, 755, 258
At Baker Bay, Wash	1, 414	7
Columbia and Lower Willamette Rivers below Vancouver, Wash., and Portland, Oreg	22, 257, 842	1, 470, 831
At Bonneville, Oreg	1, 940, 273	1, 940
At McNary lock and dam, Oreg. and Wash	1, 117, 006	894

See footnotes at end of table.

Exhibit B–5. Commerce on Project Waterways, Calendar Year 1962—Continued

(In tons of 2,000 pounds)

Waterway	Tons	Total ton miles (000 omitted)
PACIFIC COAST—Continued		
Columbia River—Continued		
Between Wenatchee and Kettle Falls, Wash	335, 343	10, 239
Vancouver, Wash., to The Dalles, Oreg	4, 132, 577	165, 620
The Dalles Dam, Oreg. and Wash	1, 476, 393	1, 181
Columbia River and tributaries above The Dalles Dam to McNary lock and dam, Oreg. and Wash	1, 542, 715	139, 777
Columbia River and tributaries above McNary lock and dam to Kennewick, Wash	1, 118, 298	35, 563
Columbia Slough, Oreg	3, 454	19
Coos and Millicoma Rivers, Oreg	1, 051, 869	4, 733
Coquille River, Oreg	407, 408	3, 870
Coquille River, Oreg. (entrance)	251, 992	277
Cowlitz River, Wash	107, 819	442
Coyote Hill Slough, Calif.[2]		
Deep River, Wash	368, 911	1, 845
Dry Pass, Alaska [2]		
Egegik River, Alaska [2]		
Elokomin Slough, Wash	197, 032	197
Feather River, Calif.[2]		
Flathead Lake, Mont.[2]		
Gastineau Channel, Alaska [2]		
Grays River, Wash	591	3
Hoquiam River, Wash	797, 493	6, 380
Kootenai River, Idaho and Mont.[2]		
Lake River, Wash	23, 996	114
Lake Washington ship canal, Wash	2, 604, 348	
Lewis River, Wash	116, 599	735
Middle River and connecting channels, Calif	14, 785	90
Mokelumne River, Calif	52, 210	418
Multnomah Channel, Oreg	888, 415	5, 330
Naknek River, Alaska	31, 858	319
Napa River, Calif	176, 685	2, 739
Neah Bay, Wash	221, 787	
Nehalem Bay, Oreg.[2]		
Noyo River, Calif	2, 243	3
Old River, Calif	183, 894	5, 333
Petaluma River, Calif	309, 167	6, 029
Quillayute River, Wash	757	1
Rogue River, Oreg	68, 011	1, 768
Sacramento River, Calif	1, 961, 994	117, 145
San Joaquin River, Calif	4, 182, 908	140, 391
San Pablo Bay and Mare Island Strait, Calif	19, 809, 109	[3]
San Rafael Creek, Calif.[2]		

See footnotes at end of table.

Exhibit B–5. Commerce on Project Waterways, Calendar Year 1962—Continued

(In tons of 2,000 pounds)

Waterway	Tons	Total ton miles (000 omitted)
PACIFIC COAST—Continued		
Siuslaw River, Oreg	367, 285	2, 571
Skagit River, Wash	2, 955	33
Skamokawa Creek, Wash	45, 484	14
Skamokawa (Steamboat Slough), Wash	45, 946	11
Skipanon Channel, Oreg	193, 125	367
Smith River, Oreg	271, 187	2, 983
Snake River, Oreg., Wash., and Idaho	554, 434	2, 215
Ice Harbor lock and dam, Snake River, Wash.[6]	36, 651	18
Stikine River, Alaska [2]	----------	----------
Stillaguamish River, Wash	20, 415	122
Suisun Bay Channel, Calif	10, 240, 069	86, 088
Suisun Channel, Calif	412, 405	5, 361
Swinomish Slough, Wash	492, 986	4, 930
Tillamook Bay and Bar, Oreg	39, 105	274
Umpqua River, Oreg	706, 122	7, 767
Waterway connecting Port Townsend Bay and Oak Bay, Wash	572, 298	515
Westport Slough, Oreg	122, 634	86
Willamette River above Portland and Yamhill River, Oreg	3, 822, 134	59, 116
Willamette River at Willamette Falls, Oreg.[7]	1, 246, 594	374
Wrangell Narrows, Alaska	231, 093	3, 813
Yaquina River, Oreg	650, 104	5, 851
Youngs Bay and Youngs River, Oreg	1, 252, 380	4, 383
GREAT LAKES		
Calumet-Sag Channel, Ill	5, 010, 396	112, 575
Channels in Lake St. Clair, Mich	86, 356, 924	(5)
Chicago River (Main and North Branch), Ill	3, 420, 787	12, 109
Chicago River (South Branch), Ill	5, 531, 446	18, 415
Chicago Sanitary and ship canal, Illinois	21, 306, 936	388, 892
Detroit River, Mich	100, 039, 108	2, 736, 591
Grays Reef Passage, Mich	6, 252, 031	(3)
Keeweenaw Waterway, Mich	599, 911	(3)
Lake Calumet, Ill	832, 378	(3)
Niagara River, N.Y	3, 092, 134	(3)
Rouge River, Mich	11, 108, 304	(3)
Saginaw River, Mich	5, 041, 897	(3)
St. Clair River, Mich	87, 237, 089	4, 880, 649
St. Marys Falls Canal, Mich. (U.S. Canal)	78, 800, 312	(3)
St. Marys River, Mich	83, 217, 124	4, 499, 728
Sturgeon Bay and Lake Michigan Ship Canal, Wis	435, 164	(3)

See footnotes at end of table.

Exhibit B–5. Commerce on Project Waterways, Calendar Year 1962—Continued

(In tons of 2,000 pounds)

Waterway	Tons	Total ton miles (000 omitted)
MISSISSIPPI RIVER SYSTEM		
Allegheny River, Pa., improved portion	4, 441, 004	58, 369
Allegheny River, Pa., open channel portion	112, 308	112
Arkansas River, Ark. and Okla	1, 591, 476	10, 552
Atchafalaya River, La	4, 713, 788	428, 172
Bayous:		
Bartholomew, La. and Ark.[2]		
D'Arbonne and Corney, La.[2]		
Big Sandy River, Tug and Levisa Forks, Ky. and W. Va	835, 951	3, 274
Big Sunflower River, Miss.[2]		
Black River, Ark. and Mo.[2]		
Black River, Wis	360, 093	298
Boeuf River, La.[2]		
Cumberland River, mouth to Burnside, Ky. (net)	3, 130, 425	461, 680
Mouth to Nashville, Tenn	3, 130, 425	459, 910
Nashville, Tenn., to Burnside, Ky	89, 157	1, 770
French Broad and Little Pigeon Rivers, Tenn	42, 950	430
Green and Barren Rivers, Ky	8, 494, 301	737, 485
Illinois and Mississippi Canal, Ill.[2]		
Illinois River, Ill	25, 358, 514	4, 943, 208
Kanawha River, W. Va	11, 138, 098	617, 627
Kentucky River, Ky	432, 206	29, 245
Little Kanawha River, W. Va	297, 837	719
Little River, La.[2]		
Little Sunflower River, Miss.[2]		
Minnesota River, Minn	1, 923, 190	23, 598
Mississippi River:		
Minneapolis, Minn., to mouth of Passes (net)	149, 897, 602	47, 601, 323
Minneapolis, Minn., to mouth of Missouri River	30, 526, 626	5, 316, 627
Mouth of Missouri River to mouth of Ohio River	35, 190, 454	5, 225, 531
Mouth of Ohio River to but not including Baton Rouge, La	46, 309, 890	24, 962, 211
Baton Rouge, La., to but not including New Orleans, La	66, 755, 381	5, 293, 309
New Orleans, La., to mouth of Passes	93, 752, 682	6, 803, 645
Mississippi River—Gulf Outlet, La	600, 918	20, 030
Missouri River:		
Fort Benton, Mont., to the mouth (net)	8, 468, 705	989, 414
Kansas City to the mouth	5, 595, 751	781, 654
Omaha to Kansas City	2, 365, 541	197, 489
Sioux City to Omaha	1, 251, 651	6, 086
Fort Benton to Sioux City	449, 896	4, 184

See footnotes at end of table.

Exhibit B–5. Commerce on Project Waterways, Calendar Year 1962—Continued

(In tons of 2,000 pounds)

Waterway	Tons	Total ton miles (000 omitted)
MISSISSIPPI RIVER SYSTEM—Continued		
Monongahela River, Pa. and W. Va	27, 782, 767	1, 324, 840
Mouth of Yazoo River, Miss	808, 220	1, 876
Muskingum River, Ohio	25, 119	5
Ohio River, Pittsburgh to Mouth	85, 306, 058	19, 709, 800
Ouachita and Black Rivers, Ark. and La	367, 359	56, 025
Ouachita River above Camden, Ark.[2]		
Red River below Fulton, Ark	394, 260	8, 905
Rough River, Ky.[2]		
St. Croix River, Wis. and Minn	33, 357	767
St. Francis and L'Anguille Rivers and Blackfish Bayou, Ark.[2]		
Saline River, Ark.[2]		
Steele and Washington Bayous and Lake Washington, Miss.[2]		
Tallahatchie and Coldwater Rivers, Miss.[2]		
Tennessee River, Tenn., Ala., and Ky	13, 115, 379	2, 268, 792
Tensas River and Bayou Macon, La.[2]		
Tradewater River, Ky.[2]		
Upper White River, Ark	43, 400	217
White River, Ark., below Batesville, Ark	539, 099	16, 897
Wolf River, Tenn	931, 724	2, 003
Yazoo River, Miss	128, 301	3, 952
Youghiogheny River, Pa	29, 100	6
OTHER WATERWAYS		
Fox River, Wis.[2]		
Grand River, Mich	1, 347, 011	20, 205
St. Joseph River, Mich	22, 000	154

[1] Less than 500 ton-miles.
[2] No commerce reported.
[3] Ton-miles not reported.
[4] Included in Delaware River, Philadelphia, Pa., to the sea.
[5] Included in St. Clair River.
[6] Included in Snake River.
[7] Included in Willamette River above Portland and Yamhill River.

Exhibit B–6. Navigation Locks and Dams Operable June 30, 1963 [1] [2]

Name of project	Miles above mouth	Community in vicinity	Locks					Dams		Calendar year completed	Impoundment		
			Width of chamber (feet)	Available length for full width (feet)	Lift at normal pool level (feet)	Depth on miter sills		Type [3]	Length (feet)		Length (miles)	Authorized channel	
						Upper (feet)	Lower (feet)					Depth (feet)	Width (feet)
Allegheny River, Pa. and N.Y.:													
Lock and dam No. 2	6.7	Aspenwall, Pa	56	360	11	11	19	Fixed	1,393	1934	7.8	9	200.
Lock and dam No. 3	14.5	Cheswick, Pa	56	360	13	12	11	do	1,436	1934	9.7	9	200.
Lock and dam No. 4	24.2	Natrona, Pa	56	360	10	9	10	do	876	1927	6.2	9	200.
Lock and dam No. 5	30.4	Freeport, Pa	56	360	12	10	11	do	780	1927	5.9	9	200.
Lock and dam No. 6	36.3	Clinton, Pa	56	360	12	11	11	do	1,140	1928	9.4	9	200.
Lock and dam No. 7	45.7	Kittanning, Pa	56	360	13	11	10	do	916	1931	6.9	9	200.
Lock and dam No. 8	52.6	Templeton, Pa	56	360	18	14	10	do	984	1937	9.6	9	200.
Lock and dam No. 9	62.2	Rimerton, Pa	56	360	22	11	11	do	950	1938	9.8	9	200.
Apalachicola, Chattahoochee, and Flint Rivers, Ga., Ala., and Fla.:													
Jim Woodruff lock and dam [6]	107.6	Chattahoochee, Fla	82	450	33	14	14	Movable	5,924	1957	46.7	6	100.
Columbia lock and dam	154.3	Columbia, Ga	82	450	25	19	13	do	620	1963	28.5	6	100.
Walter F. George lock and dam [6]	182.8	Ft. Gaines, Ga	82	450	88	18	13	do	13,371	1963	85.0	6	100.
Atlantic Intracoastal Waterway:													
Albemarle and Chesapeake Canal Route:													
Great Bridge lock	[4] 11.5	Great Bridge, Va	75	600	3	[14] 16	[14] 16	None		1932		12	90.
Dismal Swamp Canal Route:													
Deep Creek lock	[4] 10.6	Deep Creek, Va	52	300	12	[14] 12	[14] 12	do		1940	22	10	100.
South Mills lock	[4] 33.2	South Mills, N.C	52	300	12	[14] 12	[14] 13	do		1941		9	50.
Bayou Teche, La.:													
Berwick lock	[5] 1.5	Berwick, La	45	300	[13] 7	[14] 9	[14] 9	do		1951		8	80.
Keystone lock	[5] 82.5	New Iberia, La	36	160	8	8	8	Movable	175	1913	34.5	6	60.
Black Rock Channel and Tonawanda Harbor, N.Y.:													
Black Rock lock	0.0	Buffalo, N.Y	68	625	5	22	22	None		1914			

See footnotes at end of table.

Exhibit B–6. Navigation Locks and Dams Operable June 30, 1963 [1] [2]—Continued

Name of project	Miles above mouth	Community in vicinity	Locks					Dams		Calendar year completed	Impoundment		
			Width of chamber (feet)	Available length for full width (feet)	Lift at normal pool level (feet)	Depth on miter sills		Type [3]	Length (feet)		Length (miles)	Authorized channel	
						Upper (feet)	Lower (feet)					Depth (feet)	Width (feet)
Black Warrior, Warrior, and Tombigbee Rivers, Ala.:													
Jackson lock and dam	116.7	Coffeeville, Ala	110	600	34	13	13	Movable	1,175	1961	96.7	9	200.
Demopolis lock and dam	213.4	Demopolis, Ala	110	600	40	13	13	Fixed	1,485	1956	47.7	9	200.
Warrior lock and dam	261.1	Eutaw, Ala	110	600	22	13	13	Movable	1,832	1957	77.1	9	200.
Wm. Bacon Oliver lock and dam.	338.2	Tuscaloosa, Ala	95	460	28	11	11	Fixed	700	1940	9.4	9	200.
Lock and dam No. 13	347.5	Peterson, Ala	52	286	10	11	11	do	640	1905	3.5	9	200.
Lock and dam No. 14	351.0	do	52	282	15	10	10	do	930	1910	6.8	9	200.
Lock and dam No. 15	357.8	Northport, Ala	52	282	14	10	10	do	870	1910	6.2	9	200.
Lock and dam No. 16	364.0	Adger, Ala	52	286	21	10	10	do	1,045	1915	1.5	9	200.
John Hollis Bankhead lock and dam.	365.5	do	52	286	72	10	10	do	1,170	1915	42.3	9	200.
Cape Fear River, N.C.:			52	286	72	10	10						
Lock and dam No. 1	67.0	Kings Bluff, N.C	40	200	11	9	9	Fixed	275	1934	32.0	8	100.
Lock and dam No. 2	99.0	Browns Landing, N.C	40	200	9	12	12	do	229	1917	24.0	8	100.
Lock and dam No. 3	123.0	Tolars Landing, N.C	40	300	9	9	9	do	220	1935	20.0	8	100.
Columbia River, Oreg. and Wash.:													
Bonneville lock and dam [6]	145.3	Bonneville, Oreg	76	500	65	24	24	Movable	1,230	1937	47.5	27	300.
The Dalles lock and dam [6]	192.8	The Dalles, Oreg	86	675	88	20	18	do	1,450	1957	25.0	27	300.
McNary lock and dam [6]	292.0	Umatilla, Oreg	86	675	92	20	12	do	7,600	1953	64.0	12	Not specified.
Cumberland River, Ky. and Tenn.:													
Lock and dam F	43.6	Eddyville, Ky	52	280	11	11	12	do	410	1923	22.7	6	150.
Lock and dam E	66.3	Cadiz, Ky	52	280	10	11	11	do	452	1922	21.7	6	150.
Lock and dam D	88.0	Cumberland City, Tenn	52	280	11	10	10	do	443	1916	20.5	6	150.
Lock and dam C	108.5	Sailors Rest, Tenn	52	280	12	11	10	do	460	1918	31.8	6	150.
Lock and dam B	140.3	Hickory Point, Tenn	52	280	12	10	10	do	440	1916	8.4	6	150.
Cheatham lock and dam [6]	148.7	Ashland City, Tenn	110	800	26	17	17	do	480	1959	67.5	9	150.
Old Hickory lock and dam [6]	216.2	Old Hickory, Tenn	84	400	60	17	13	do	355	1957	97.3	9	150.

Fox River, Wis.:													
DePere lock	7.1	DePere, Wis	36	146	9	10	12			1936	5.9	6	100.
DePere Dam	7.2	do						Movable	986	1929			
Little Kaukauna lock	13.0	do	36	146	7	8	10			1938	6.2	6	100.
Little Kaukauna Dam	13.1	do						Movable	588	1926			
Rapide Croche lock	19.2	Wrightstown, Wis	36	146	8	9	9			1934	3.6	6	100.
Rapide Croche Dam	19.3	do						Movable	461	1930			
Kaukauna Fifth lock	22.8	Kaukauna, Wis	36	144	9	7	7			1898	0.3	6	100.
Kaukauna Fourth lock	23.1	do	37	144	10	7	6			1928	0.2	6	100.
Kaukauna Third lock	23.3	do	37	144	10	7	6			1930	0.1	6	100.
Kaukauna Second lock	23.4	do	35	144	10	6	6			1930	0.2	6	100.
Kaukauna First lock	23.6	do	35	144	11	7	6			1925	0.4	6	100.
Kaukauna Dam	24.0	do						Movable	603	1931			
Kaukauna guard lock	24.0	do	40			9				1891	1.4	6	100.
Little Chute combined lock:													
Lower	25.4	Little Chute, Wis	35	147	11	6	9			1926		6	100.
Upper	25.4	do	36	144	11	8	6			1926	1.0	6	100.
Little Chute Second lock	26.4	do	35	144	14	8	6			1927	0.1	6	100.
Little Chute First (guard) lock	26.5	do	35			7				1934	0.8	6	100.
Little Chute Dam	26.6	do						Movable	562	1932			
Cedars lock	27.3	do	35	144	10	7	7			1924	3.4	6	100.
Cedars Dam	27.4	do						Movable	654	1933			
Appleton Fourth lock	30.7	Appleton, Wis	35	144	8	8	8			1934	0.6	6	100.
Appleton Lower Dam	30.9	do						Movable	549	1963			
Appleton Third lock	31.3	do	35	144	9	6	9			1929	0.3	6	100.
Appleton Second lock	31.6	do	35	145	10	7	6			1929	0.3	6	100.
Appleton First lock	31.9	do	35	145	10	7	6			1926	5.1	6	100.
Appleton Upper Dam	32.2	do						Movable	691	1940			
Menasha lock	37.0	Menasha, Wis	35	144	8	7	8			1928	44.0	6	100.
Menasha Dam	37.8	do						Movable	401	1956			
Green and Barren Rivers, Ky.:													
Green River:													
Lock and dam No. 1	9.1	Spottsville, Ky	84	600	12	12	11	Fixed	482	1956	54.0	9	200.
Lock and dam No. 2	63.1	Calhoun, Ky	84	600	14	15	12	do	519	1956	45.4	9	200.
Lock and dam No. 3	108.5	Rochester, Ky	36	138	17	7	6	do	353	1836	40.5	6	200.
Lock and dam No. 4	149.0	Woodbury, Ky	36	138	16	7	7	do	409	1839	19.1	6	200.
Barren River:													
Lock and dam No. 1	15.0	Greencastle, Ky	56	360	15	12	9	do	276	1934	15.1	6	200.

See footnotes at end of table.

Exhibit B-6. Navigation Locks and Dams Operable June 30, 1963 [1] [2]—Continued

Name of project	Miles above mouth	Community in vicinity	Locks					Dams		Calendar year completed	Impoundment		
			Width of chamber (feet)	Available length for full width (feet)	Lift at normal pool level (feet)	Depth on miter sills		Type [3]	Length (feet)		Length (miles)	Authorized channel	
						Upper (feet)	Lower (feet)					Depth (feet)	Width (feet)
Gulf Intracoastal Waterway:													
Inner Harbor Navigation Canal lock.	[7] 2.9	New Orleans, La.	75	640	[13] 9	[14] 32	[14] 32	None		1923		12	150.
Harvey lock	[7] 3.3	Harvey, La.	75	425	[13] 10	[14] 12	[14] 12	do		1935		12	125.
Algiers lock	[7] 7.0	Algiers, La.	75	760	[13] 10	[14] 13	[14] 13	do		1956		12	125.
Bayou Boeuf lock	[7] 96.6	Morgan City, La.	75	1,160	[13] 6	[14] 13	[14] 13	do		1954		12	125.
Bayou Sorrel lock	[7] 131.0	Plaquemine, La.	56	760	[13] 10	[14] 14	[14] 14	do		1952		12	125.
Port Allen lock	[7] 132.5	Port Allen, La.	84	1,200	45	[14] 14	[14] 14	do		1961		12	125.
Vermilion lock	[7] 161.5	Abbeville, La.	56	1,182	[13] 3	[14] 11	[14] 11	do		1934		12	125.
Calcasieu lock	[7] 238.5	Lake Charles, La.	75	1,180	[13] 2	[14] 13	[14] 13	do		1950		12	125.
Colorado River, Tex.	[7] 441.5	Matagorda, Tex.						do		1954		12	125.
East lock			75	1,200	[13] 5	[14] 15	[14] 15						
West lock			75	1,200	[13] 5	[14] 15	[14] 15						
Hudson River, N.Y.:													
Troy lock and dam	153.8	Troy, N.Y.	44	493	17	16	13	Fixed	1,450	1917	2.2	14	400.
Ice Harbor lock and dam [6]	9.7	Pasco, Wash.	86	675	100	18	19	Movable	2,700	1962	31.9	15	250.
Illinois Waterway, Ill.:													
LaGrange lock and dam	80.2	Beardstown, Ill.	110	600	10	16	13	do	1,066	1939	77.5	9	300.
Peoria lock and dam	157.7	Peoria, Ill.	110	600	11	16	12	do	536	1939	73.3	9	300.
Starved Rock lock and dam	231.0	Utica, Ill.	110	600	19	17	14	do	1,280	1933	13.6	9	300.
Marseilles lock	244.6	Marseilles, Ill.	110	600	24	19	14			1933	26.9	9	300.
Marseilles dam	247.0	do						Movable	819	1933	24.6		
Dresden Island lock and dam	271.5	Morris, Ill.	110	600	22	17	12	do	1,506	1933	14.5	9	300.
Brandon Road lock and dam	286.0	Joliet, Ill.	110	600	34	18	14	do	2,391	1933	5.1	9	300.
Lockport lock	291.1	Lockport, Ill.	110	600	40	12	15	None		1933	34.5	9	300.
Thomas J. O'Brien lock and dam.	326.5	Chicago, Ill.	110	1,000	2	14	14	Movable	257	1960	6.9	9	300.

Kanawha River, W. Va.:													
Winfield lock and dam	31.1	Winfield (Red House)	56	360	28	18	12	do	677	1937	36.7	9	300.
		W. Va	56	360	28	18	12						
Marmet lock and dam	67.8	Marmet (Belle), W. Va	56	360	24	18	12	do	557	1934	15.0	9	300.
			56	360	24	18	12						
London lock and dam	82.8	London, W. Va	56	360	24	18	12	do	557	1934	7.8	9	300.
			56	360	24	18	12						
Kentucky River, Ky.:													
Lock and dam No. 1	4.0	Carrolton, Ky	38	145	8	8	15	Fixed	424	1839	27.0	6	100.
Lock and dam No. 2	31.0	Lockport, Ky	38	145	14	8	6	do	400	1839	11.0	6	100.
Lock and dam No. 3	42.0	Gest, Ky	38	145	13	9	7	do	465	1844	23.0	6	100.
Lock and dam No. 4	65.0	Frankfort, Ky	38	145	13	6	6	do	543	1844	17.2	6	100.
Lock and dam No. 5	82.2	Tyrone, Ky	38	145	15	10	6	do	556	1844	14.0	6	100.
Lock and dam No. 6	96.2	High Bridge, Ky	52	147	14	9	6	do	413	1891	20.8	6	100.
Lock and dam No. 7	117.0	do	52	147	15	9	7	do	350	1897	22.9	6	100.
Lock and dam No. 8	139.9	Camp Nelson, Ky	52	146	19	11	6	do	257	1900	17.6	6	100.
Lock and dam No. 9	157.5	Valley View, Ky	52	148	17	11	7	do	242	1907	18.9	6	100.
Lock and dam No. 10	176.4	Ford, Ky	52	148	17	9	6	do	250	1907	24.6	6	100.
Lock and dam No. 11	201.0	Irvine, Ky	52	148	18	10	6	do	208	1906	19.9	6	100.
Lock and dam No. 12	220.9	Ravenna, Ky	52	148	17	10	6	do	240	1910	19.0	6	100.
Lock and dam No. 13	239.9	Willow, Ky	52	148	18	10	6	do	248	1915	9.1	6	100.
Lock and dam No. 14	249.0	Heidelberg, Ky	52	148	17	9	6	do	248	1917	9.6	6	100.
Lake Washington ship canal:													
Hiram M. Chittenden locks:													
Large lock	1.3	Seattle, Wash	80	760	25	36	29	Movable	235	1916	17.0	34	150.
Small lock			28	123	25	16	16						
Mississippi River between Ohio and Missouri Rivers:													
Locks and dam No. 27	[8] 185.1	Granite City, Ill	110	1,200	21	16	15	Fixed	3,240	1963	17.8	9	200.
			110	600	21	16	15						
Mississippi River between Missouri River and Minneapolis, Minn.:													
Locks and dam No. 26	202.9	Alton, Ill	110	600	23	19	11	Movable	1,725	1937	38.5	9	200.
			110	360	23	16	11						
Lock and dam No. 25	241.4	Cap Au Gris, Mo	110	600	15	19	12	do	1,296	1939	32.0	9	200.
Lock and dam No. 24	273.4	Clarksville, Mo	110	600	15	19	12	do	1,340	1940	27.8	9	200.
Lock and dam No. 22	301.2	Saverton, Mo	110	600	10	18	14	do	1,024	1938	23.7	9	Not specified.

See footnotes at end of table.

Exhibit B–6. Navigation Locks and Dams Operable June 30, 1963 [1] [2]—Continued

Name of project	Miles above mouth	Community in vicinity	Locks					Dams		Calendar year completed	Impoundment		
			Width of chamber (feet)	Available length for full width (feet)	Lift at normal pool level (feet)	Depth on miter sills		Type [3]	Length (feet)		Length (miles)	Authorized channel	
						Upper (feet)	Lower (feet)					Depth (feet)	Width (feet)
Mississippi River between Missouri River and Minneapolis, Minn.—Continued													
Lock and dam No. 21	324.9	Quincy, Ill	110	600	10	17	12	do	1,066	1938	18.3	9	Not specified.
Lock and dam No. 20	343.2	Canton, Mo	110	600	10	15	12	do	2,144	1936	21.0	Same for waterway through Lock and dam No. 1.	
Lock and dam No. 19	364.2	Keokuk, Iowa	110	358	38	14	9	Fixed	4,434	1913	46.3		
			110	1,200	38	15	13			1957			
Lock and dam No. 18	410.5	Burlington, Iowa	110	600	10	17	14	Movable	1,350	1937	26.6		
Lock and dam No. 17	437.1	New Boston, Ill	110	600	8	16	13	do	921	1939	20.1		
Lock and dam No. 16	457.2	Muscatine, Iowa	110	600	9	17	12	do	1,099	1937	25.7		
Lock and dam No. 15	482.9	Rock Island, Ill	110	600	16	27	11	do	1,203	1934	10.4		
			110	360	16	27	11						
Lock and dam No. 14	493.1	Le Claire, Iowa	80	320	11	18	11			1922			
	493.3	do	110	600	11	21	14	Movable	1,343	1939	29.2		
Lock and dam No. 13	522.5	Clinton, Iowa	110	600	11	19	13	do	1,066	1939	34.2		
Lock and dam No. 12	556.7	Bellevue, Iowa	110	600	9	17	13	do	849	1939	26.3		
Lock and dam No. 11	583.0	Dubuque, Iowa	110	600	11	19	13	do	1,278	1937	32.1		
Lock and dam No. 10	615.1	Guttenberg, Iowa	110	600	8	15	12	do	763	1936	32.8		
Lock and dam No. 9	647.9	Lynxville, Wis	110	600	9	16	13	do	811	1938	31.3		
Lock and dam No. 8	679.2	Genoa, Wis	110	600	11	22	14	do	897	1937	23.3		
Lock and dam No. 7	702.5	Dresbach, Minn	110	600	8	18	12	do	940	1937	11.8		
Lock and dam No. 6	714.3	Trempealeau, Wis	110	600	6	17	13	do	893	1936	14.2		
Lock and dam No. 5A	728.5	Winona, Minn	110	600	5	18	13	do	682	1936	9.6		
Lock and dam No. 5	738.1	Minneiska, Minn	110	600	9	18	12	do	1,619	1935	14.7		
Lock and dam No. 4	752.8	Alma, Wis	110	600	7	17	13	do	1,367	1935	44.1		
Lock and dam No. 3	796.9	Red Wing, Minn	110	600	8	17	14	do	365	1938	18.3		
Lock and dam No. 2	815.2	Hastings, Minn	110	600	12	22	13	do	822	1930	32.4		
			110	500	12	16	15			1948			
Lock and dam No. 1	847.6	Minneapolis-St. Paul	56	400	36	13	8	Fixed	574	1932	5.7		
			56	400	36	13	10			1917			

St. Anthony Falls lower lock and dam.	853.3	Minneapolis, Minn.	56	400	27	14	10	Movable	188	1959	.5	9	100.
St. Anthony Falls upper lock and dam.	853.8	do	56	400	49	16	14	Fixed	3,584	1963	3.8	9	100.
Monongahela River, W. Va. and Pa.:													
Locks and dam No. 2	11.2	Braddock, Pa.	56	360	9	16	16	do	748	1951	12.6	9	125.
			110	720	9	16	16			1953			
Locks and dam No. 3	23.8	Elizabeth, Pa.	56	360	8	12	12	Fixed	688	1907	17.7	9	125.
			56	720	8	12	12			1907			
Locks and dam No. 4	41.5	Charleroi, Pa.	56	360	11	14	11	Fixed	553	1932	15.0	9	125.
			56	720	11	14	11			1932			
Locks and dam No. 5	56.5	Brownsville, Pa.	56	360	12	12	11	Fixed	555	1909	11.8	9	125.
			56	360	12	12	11			1909			
Locks and dam No. 6	68.3	Rices Landing, Pa.	56	360	13	11	11	Fixed	623	1916	16.7	9	125.
			56	360	13	11	11			1916			
Lock and dam No. 7	85.0	Greensboro, Pa.	56	360	15	11	10	Fixed	610	1926	5.8	9	125.
Lock and dam No. 8	90.8	Point Marion, Pa.	56	360	19	11	10	Movable	560	1959	11.2	9	125.
Morgantown lock and dam	102.0	Morgantown, W. Va.	84	600	17	18	15	do	410	1950	6.0	9	125.
Hildebrand lock and dam	108.0	do	84	600	21	9	9	do	530	1960	7.3	9	125.
Lock and dam No. 14	115.3	Lowsville, W. Va.	56	182	11	7	7	Fixed	446	1903	9.3	9	125.
Lock and dam No. 15	124.6	Hoult, W. Va.	56	182	11	7	7	do	430	1903	4.1	7	125.
Ohio River												9	300.
Lock and dam No. 53	18.4	Mound City, Ill.	110	600	13	15	10	Movable	3,978	1929	23.7	Same for entire length of waterway.	
Lock and dam No. 52	42.1	Brookport, Ill.	110	600	12	15	11	do	3,073	1928	35.8		
Lock and dam No. 51	77.9	Golconda, Ill.	110	600	8	15	11	do	2,445	1929	26.3		
Lock and dam No. 50	104.2	Weston, Ky.	110	600	10	17	11	do	2,630	1928	31.8		
Lock and dam No. 49	136.0	Uniontown, Ky.	110	600	11	17	13	do	1,542	1928	35.4		
Lock and dam No. 48	171.4	Henderson, Ky.	110	600	7	15	13	do	2,320	1922	31.9		
Lock and dam No. 47	203.3	Newburgh, Ind.	110	600	9	15	11	do	2,045	1928	20.4		
Lock and dam No. 46	223.7	Owensboro, Ky.	110	600	11	17	11	do	2,520	1928	54.3		
Lock and dam No. 45	278.0	Addison, Ky.	110	600	9	17	13	do	1,460	1927	39.8		
Lock and dam No. 44	317.8	Leavenworth, Ind.	110	600	7	15	13	do	1,460	1925	30.0		
Lock and dam No. 43	347.8	West Point, Ky.	110	600	9	15	11	do	1,538	1922	26.4		
McAlpine locks and dam	374.2	Louisville, Ky.	110	1,200	37	49	12	do	8,627	1963	75.3		
			110	600	37	19	11			1921			
			56	360	37	19	11			1930			
Markland locks and dam	449.5	Markland, Ind.	110	1,200	35	50	15	Movable	1,395	1959	193.5		
			110	600	35	50	15			1959			

See footnotes at end of table.

Exhibit B–6. Navigation Locks and Dams Operable June 30, 1963[1][2]—Continued

Name of project	Miles above mouth	Community in vicinity	Locks					Dams		Calendar year completed	Impoundment		
			Width of chamber (feet)	Available length for full width (feet)	Lift at normal pool level (feet)	Depth on miter sills		Type[3]	Length (feet)		Length (miles)	Authorized channel	
						Upper (feet)	Lower (feet)					Depth (feet)	Width (feet)
Ohio River—Continued												9	300.
Lock and dam No. 34	546.9	Chilo, Ohio	110	600	6	15	11	Movable	1,556	1925	29.0	Same for entire length of waterway.	
Lock and dam No. 33	575.9	Maysville, Ky	110	600	7	15	11	do	1,136	1921	22.5		
Lock and dam No. 32	598.4	Rome, Ohio	110	600	7	15	11	do	1,360	1926	23.3		
Lock and dam No. 31	621.7	Portsmouth, Ohio	110	600	7	15	11	do	1,080	1919	18.3		
Greenup locks and dam	640.0	Greenup, Ky	110	600	32	18	13	do	1,287	1962	61.8		
			110	1,200	32	18	13						
Gallipolis locks and dam	701.8	Hogsett, W. Va	110	360	26	18	12	Movable	1,116	1937	47.8		
			110	600	26	18	12						
Lock and dam No. 23	749.6	Millwood, W. Va	110	600	6	15	14	Movable	1,012	1921	10.5		
Lock and dam No. 22	760.1	Ravenswood, W. Va	110	600	8	15	11	do	1,044	1918	6.3		
Lock and dam No. 21	766.4	Portland, Ohio	110	600	6	15	11	do	1,088	1919	12.1		
Lock and dam No. 20	778.5	Belleville, W. Va	110	600	7	15	11	do	1,012	1918	10.3		
Lock and dam No. 19	788.8	Little Hocking, Ohio	110	600	8	17	11	do	1,212	1916	12.3		
Lock and dam No. 18	801.1	Parkersburg, W. Va	110	600	6	14	11	do	1,135	1910	12.4		
Lock and dam No. 17	813.5	Marietta, Ohio	110	600	8	15	11	do	1,272	1918	21.0		
Lock and dam No. 16	834.5	Ben Run, W. Va	110	600	8	15	11	do	980	1917	17.4		
Lock and dam No. 15	851.9	New Martinsville, W. Va	110	600	8	15	11	do	1,028	1916	15.1		
Lock and dam No. 14	867.0	Woodland, W. Va	110	600	8	16	11	do	956	1917	17.9		
Lock and dam No. 13	884.9	McMechen, W. Va	110	600	7	14	10	do	996	1911	8.7		
Lock and dam No. 12	893.6	Warwood, W. Va	110	600	8	15	11	do	1,120	1916	10.5		
Lock and dam No. 11	904.1	Wellsburg, W. Va	110	600	7	15	11	do	1,040	1911	10.7		
Lock and dam No. 10	914.8	Steubenville, Ohio	110	600	8	16	11	do	1,076	1915	11.8		
New Cumberland locks and dam.	926.6	Stratton, Ohio	110	600	23	19	13	do	1,315	1961	22.7		
			110	1,200	23	19	13						
Montgomery Island locks and dam.	949.3	Industry, Pa	56	360	19	16	13	Movable	1,379	1936	18.4		
			110	600	19	16	13						
Dashields locks and dam	967.7	Sewickley, Pa	56	360	10	13	18	Fixed	1,585	1929	7.1		
			110	600	10	13	18						

Emsworth locks and dam	974.8	Emsworth, Pa	56	360	18	17	13	Movable	967	1937	6.2		
			110	600	18	17	13						
Okeechobee Waterway, Fla.:													
St. Lucie lock and dam	15.1	Stuart, Fla	50	250	13	14	12	Movable	170	1941	15.1	8	80.
Moore Haven lock	78.0	Moore Haven, Fla	50	250	2	10	11	None		1953	15.6	8	90.
Ortona lock and dam	93.6	LaBelle, Fla	50	250	11	12	11	Movable	104	1937	15.6	8	90.
Oklawaha River, Fla.:													
Moss Bluff lock and dam	65.5	Ocala, Fla	30	125	11	9	5	do	54	1925		(9)	Not specified.
Old River, La	[10] 301.8	Simmesport, La	75	1,200	35	18	14	Under construction.		1963		12	125.
Ouachita and Black Rivers, Ark. and La.												6.5	100.
Lock and dam No. 2	57.6	Harrisonburg, La	55	268	15	21	6	Movable	377	1921	60.7	Channel completed to depth of 6.5 ft. Authorized in 1960 to depth of 9 ft.	
Lock and dam No. 3	118.3	Riverton, La	55	268	15	21	7	do	399	1920	44.1		
Lock and dam No. 4	162.4	Monroe, La	55	268	9	15	7	do	411	1922	30.2		
Lock and dam No. 5	192.6	Sterlington Reach, La	55	268	7	14	7	do	311	1926	30.4		
Lock and dam No. 6	223.0	Felsenthal, Ark	55	268	10	14	7	do	314	1923	58.8		
Lock and dam No. 8	281.8	Calion, Ark	55	268	14	16	7	do	306	1926	53.5		
Pearl River, Miss. and La.:													
Lock 1	29.4	Pearl River, La	65	310	27	10	10	None		1951	11.3	7	80.
Lock 2	40.7	Bush, La	65	310	15	10	10	do		1951	3.2	7	80.
Lock 3	43.9	Sun, La	65	310	11	10	10	do		1951	13.3	7	80.
Sacramento River (Barge Canal lock).	42.8	West Sacramento, Calif	86	600	4	13	13	do		1961	1.5	13	120.
St. Marys River, Mich												27	Not specified.
South Canal:													
MacArthur lock	47.0	Sault Ste. Marie, Mich	80	800	22	31	31	None		1943			
North Canal:													
Davis lock	47.0	do	80	1,350	22	24	23	do		1914			
Sabin lock	47.0	do	80	1,350	22	24	23	do		1919			
Savannah River, Ga.:													
Lock and dam	203.0	Augusta, Ga	56	360	15	14	12	Movable	363	1936	16.2	9	90.
Tennessee River, Tenn., Ala., Miss., and Ky. [11]												9	300.
Kentucky lock and dam	22.4	Gilbertsville, Ky	110	600	57	11	13	do	1,176	1944	184.3	Same for length of waterway from mouth through Fort Loudoun lock and dam.	
Pickwick Landing lock and dam.	206.7	Hamburg, Tenn	110	600	55	10	13	do	1,141	1937	52.7		
Wilson lock and dam	259.4	Florence, Ala	110	600	94	13	13	do	2,300	1959	15.5		
(Upper lift)		do	60	292	47	11	11			1927			
(Lower lift)		do	60	300	47	11	11			1927			

See footnotes at end of table.

Exhibit B–6. Navigation Locks and Dams Operable June 30, 1963 [1] [2]—Continued

Name of project	Miles above mouth	Community in vicinity	Locks					Dams		Calendar year completed	Impoundment		
			Width of chamber (feet)	Available length for full width (feet)	Lift at normal pool level (feet)	Depth on miter sills		Type [3]	Length (feet)		Length (miles)	Authorized channel	
						Upper (feet)	Lower (feet)					Depth (feet)	Width (feet)
Tennessee River, Tenn., Ala., Miss., and Ky.[11]—Continued													
General Joe Wheeler lock and dam.	274.9	Florence, Ala.	60	400	48	15	13	Movable	2,700	1962	74.1	9	300.
			110	600	48	13	13			1963		Same for length of waterway from mouth through Fort Loudoun lock and dam.	
Guntersville lock and dam	349.0	Guntersville, Ala.	60	360	39	13	12	Movable	856	1939	82.1		
Hales Bar lock and dam	431.1	Chattanooga, Tenn.	60	265	39	17	11	do	776	1948	39.9		
Chickamauga lock and dam	471.0	do	60	360	49	10	14	do	864	1940	58.9		
Watts Bar lock and dam	529.9	Breedenton, Tenn.	60	360	58	12	12	do	960	1942	72.4		
Fort Loudoun lock and dam	602.3	Lenoir City, Tenn.	60	360	72	12	12	do	651	1943	49.8		
Melton Hill lock and dam (Clinch River).	23.1	Kingston, Tenn.	75	400	54	13	13	do	1,072	1963	38.2	9	(12)
Willamette River at Willamette Falls, Oreg.												6	Not specified.
Lock No. 1	26.0	Oregon City, Oreg.	37	175	23	6	8	None		1872			
Lock No. 2	26.0	do	37	175	9	6	8	do		1872			
Lock No. 3	26.0	do	37	175	11	6	8	do		1872			
Lock No. 4	26.0	do	37	175	8	6	8	do		1872	.4		
Guard lock	26.4	do	38	175	10	6	8	do		1872	23.6		

Total number of locks—241, including 28 auxiliary locks and 2 guard locks.

Total number of dams—162, including 8 multiple-purpose dams. Excludes 10 dams listed which are operated by Tennessee Valley Authority.

[1] Additional detail may be found in vol. 2, 1963 Annual Report.

[2] Bridge clearances set forth in the U.S. Army, Corps of Engineers publications "Bridges over Navigable Waters of the United States."

[3] Fixed crest without gates or other facility to control streamflow. Movable dam includes any type of crest gates, such as tainter gates, wickets, and others to control streamflow.

[4] Miles from Norfolk, Va.

[5] Miles from Gulf Intracoastal Waterway.

[6] Additional detail may be found in Multiple Purpose list published in vol. 1, 1962 Annual Report.

[7] Miles from New Orleans, La.

[8] Miles above the Ohio River.

[9] 6-foot depth from mouth of river to Silver Springs Run, about 57.7 miles; 4-foot depth therefrom to Leesburg, about 33.4 miles.

[10] Miles above the Head of Passes.

[11] Tennessee River locks operated by Corps of Engineers, dams operated by Tennessee Valley Authority.

[12] Width of channel 200 feet from lock to mouth of Clinch River and 175 feet upstream from lock to Clinton, Tenn.

[13] Average high and low water conditions, lift varying widely dependent on tides and river stages.

[14] Depth is that normally prevailing with reference to mean low water.

Appendix C

FLOOD CONTROL

Exhibit C–1. Reservoirs of the Corps of Engineers that Provide Flood Control as of June 30, 1963

(Storage in thousands of acre-feet. Only flood control storage is shown)

Region	Completed or in partial operation		Under construction, not operable		Authorized, not started		Total active		Deferred	Inactive	Total of active, deferred, inactive
	Number	Storage	Number	Storage	Number	Storage	Number	Storage	Number	Number	Number
Alaska											
Arkansas-White-Red	30	17, 609	13	6, 726	19	3, 445	62	27, 780	5	4	71
Central and South Pacific	11	409			1	170	12	579		5	17
Central Valley	13	2, 544	3	1, 487	8	2, 089	24	6, 120	1		25
Colorado	5	2, 350	1	805	2	134	8	3, 289			8
Columbia	11	1, 971	7	3, 620	5	5, 343	[1] 23	[1] 10, 934	1		24
Great Basin					4	55	4	55	3		7
Great Lakes and St. Lawrence	5	415					5	415		1	6
Gulf and South Atlantic	[2] 4	[2] 1, 811	2	255	2	443	8	2, 509	16		24
Hawaii											
Lower Mississippi	5	4, 412					5	4, 412			5
Middle Atlantic	13	1, 816	1	119	17	1, 502	31	3, 437	3		34
Missouri	17	19, 761	8	2, 652	16	5, 334	41	27, 747	3	6	50
New England	24	1, 002	5	59	6	92	35	1, 153	3	10	48
North Pacific	2	212			4	460	6	672			6
Ohio	39	8, 595	16	5, 147	23	2, 509	78	16, 251	12	9	99
Rio Grande and Gulf	15	5, 613	6	3, 709	9	1, 461	30	10, 783	1	4	35
Souris and Red	5	527					5	527		2	7
Upper Mississippi	11	2, 692	4	3, 009	5	1, 729	20	7, 430	5		25
Total	210	71, 739	66	27, 588	121	24, 766	397	124, 093	53	41	491

[1] Three reregulating structures, with 36,000 acre-feet of storage, are included as separate reservoirs.

[2] The Central and Southern Florida project, consisting of some 21 lakes and conservation impoundments with 10,690,000 acre-feet of storage, is not included in the region total.

Exhibit C–2. Flood Damages Prevented by Corps of Engineers Projects

(In thousands of dollars)

Region	During fiscal year 1963	Cumulative thru fiscal year 1963
Alaska	$112	$2, 458
Arkansas-White-Red	1, 356	258, 176
Central and South Pacific	32, 940	264, 605
Central Valley	260, 505	831, 775
Colorado	100	230
Columbia	4, 431	256, 660
Great Basin	300	750
Great Lakes and St. Lawrence	3, 800	24, 187
Gulf and South Atlantic	3, 587	102, 248
Hawaii	292	477
Lower Mississippi	48, 851	7, 260, 402
Middle Atlantic	4, 361	184, 219
Missouri	18, 324	1, 077, 624
New England	20	155, 589
North Pacific	232	5, 660
Ohio	133, 511	935, 813
Rio Grande and Gulf	11, 787	262, 696
Souris and Red	767	7, 529
Upper Mississippi	435	222, 645
Total	525, 711	11, 853, 743

Exhibit C-3. Flood Damages Prevented During Fiscal Year 1963

(In thousands of dollars)

Memphis District	$48,496	
New Orleans District	94	
St. Louis District	------	
Vicksburg District	362	
Lower Mississippi Valley Division		$48,952
Kansas City District	654	
Omaha District	17,670	
Missouri River Division		18,324
New England Division		--------
Baltimore District	4,049	
New York District	125	
Norfolk District	------	
Philadelphia District	------	
North Atlantic Division		4,174
Buffalo District	617	
Chicago District	350	
Detroit District	2,660	
Rock Island District	433	
St. Paul District	837	
North Central Division		4,897
Alaska District	112	
Portland District	3,448	
Seattle District	63	
Walla Walla District	1,152	
North Pacific Division		4,775
Huntington District	89,576	
Louisville District	14,423	
Nashville District	13,209	
Pittsburgh District	16,303	
Ohio River Division		133,511
Honolulu District	292	
Pacific Ocean Division		292
Charleston District	98	
Jacksonville District	------	
Mobile District	2,126	
Savannah District	872	
Wilmington District	803	
South Atlantic Division		3,899
Los Angeles District	32,000	
Sacramento District	255,305	
San Francisco District	6,540	
South Pacific Division		293,845
Albuquerque District	29	
Fort Worth District	11,659	
Galveston District	5	
Little Rock District	1,072	
Tulsa District	277	
Southwestern Division		13,042
Total		525,711

Exhibit C–4. Local Protection Projects

Completed or in Partial Operation—as of June 30, 1963

Region	Authorization		Total number
	Specific	General [1]	
Alaska	5		5
Arkansas-White-Red	58	1	59
Central and South Pacific	14	6	20
Central Valley	7	2	9
Colorado	1	1	2
Columbia	58	5	63
Great Basin	2	1	3
Great Lakes and St. Lawrence	12	4	16
Gulf and South Atlantic	15	12	[2] 27
Hawaii	1	1	2
Lower Mississippi	11	5	[3] 16
Middle Atlantic	25	20	45
Missouri	55	11	66
New England	19	14	33
North Pacific	7	10	17
Ohio	64	12	76
Rio Grande and Gulf	9	6	15
Souris and Red	8	1	9
Upper Mississippi	82	9	91
Total	453	121	574

[1] Includes small projects not specifically authorized by Congress, constructed under the small-project authority provided by sec. 205 of the 1948 Flood Control Act, as amended; excludes work under general authorities for snagging and clearing, emergency bank protection, and emergency repair projects.

[2] Central and Southern Florida is considered as one project.

[3] Mississippi River and tributaries is considered as one project.

APPENDIX D

POWER

Region	Number of projects	Capacity in operation as of June 30, 1963 (thousand kw)	Generation during fiscal year 1963 (million kwh)
Alaska			
Arkansas-White-Red	8	761	1,227
Central and South Pacific			
Central Valley			
Colorado			
Columbia	9	4,237	19,896
Great Basin			
Great Lakes and St. Lawrence	1	18	163
Gulf and South Atlantic	6	799	1,763
Hawaii			
Lower Mississippi			
Middle Atlantic	2	218	429
Missouri	5	1,580	4,663
New England			
North Pacific			
Ohio	5	595	1,749
Rio Grande and Gulf	1	30	80
Souris and Red			
Upper Mississippi			
Total	37	8,238	29,970

APPENDIX E

WATER SUPPLY AND IRRIGATION

E–1 Water Supply Storage.
E–2 Irrigation Storage.

Exhibit E–1. Water Supply Storage as of June 30, 1963

Project	Storage (acre-feet)	Local agency
In operation		
Baldhill, N. Dak.	[1] 69,500	Eastern North Dakota, Water Development Association.
Belton, Tex.	12,000	Fort Hood, Tex.
Do.	113,700	Brazos River Authority, Tex.
Berlin, Ohio	19,400	Mahoning Valley Sanitary District.
Canton, Okla.	90,000	Oklahoma City, Okla.
Clark Hill, Ga. and S.C.	210	McCormick, S.C.
Dam B, Tex.	94,200	Lower Neches Valley Authority.
East Brimfield, Mass.	1,140	American Optical Co., Massachusetts.
Ferrells Bridge, Tex.	251,100	Northeast Texas Municipal Water District.
Grapevine, Tex.	85,000	Dallas, Tex.
Do.	50,000	Park Cities, Tex.
Do.	1,250	Grapevine, Tex.
Heyburn, Okla.	1,000	Kiefer, Okla.
Homme, N. Dak.	[1] 3,650	Grafton and Park River, N. Dak.
Hords Creek, Tex.	5,780	Coleman, Tex.
Hulah, Okla.	15,400	Bartlesville, Okla.
Lake Texoma, Okla. and Tex.	21,300	Denison, Tex.
Do.	16,400	Texas Power & Light Co.
Lavon, Tex.	100,000	North Texas Municipal Water District.
Lewisville, Tex.	415,000	Dallas, Tex.
Do.	21,000	Denton, Tex.
Mosquito Creek, Ohio	11,000	Warren, Ohio.
Navarro Mills, Tex.	53,200	Trinity River Authority, Tex.
Oologah, Okla.	38,000	Tulsa, Okla.
Do.	500	Collinsville, Okla.
Do.	5,000	Public Service Co. of Okla.
Do.	2,500	Claremore Inc., Claremore, Okla.
San Angelo, Tex.	80,400	Upper Colorado River Authority.
Texarkana, Ark. and Tex.	[1] 13,400	Cities of Texarkana, Ark. and Tex.
Tom Jenkins, Ohio	5,800	State of Ohio.
Wister, Okla.	1,600	Heavener Utilities Authority.
Subtotal (rounded)	1,598,000	

See footnotes at end of table.

Exhibit E–1. Water Supply Storage as of June 30, 1963—Continued

Project	Storage (acre-feet)	Local agency
Under construction		
Bardwell, Tex	42, 800	Trinity River Authority.
Beaver, Ark	108, 000	Beaver Water District, Ark.
Belton, Tex	[2] 247, 000	Brazos River Authority.
Broken Bow, Okla	[3] 153, 000	Mountain Lakes Water District.
Canyon, Tex	366, 400	Guadalupe-Blanco River Authority Tex.
Carlyle, Ill	33, 000	State of Illinois.
Council Grove, Kans	24, 400	Council Grove and Emporia, Kans.
DeGray, Ark	[3] 238, 700	Ouachita River Water District.
Elk City, Kans	42, 300	State of Kansas.
Gillham, Ark	28, 700	Tri-Lakes Water District.
John Redmond, Kans	34, 900	State of Kansas.
Littleville, Mass	9, 400	Springfield, Mass.
McGee Bend, Tex	[3] 1, 383, 500	Lower Neches Valley Authority, Texas.
Milford, Kans	300, 000	State of Kansas.
Millwood, Ark	150, 000	Southwest Arkansas Water District.
Monroe, Ind	159, 900	State of Indiana.
Pine Creek, Okla	70, 000	Mountain Lakes Water District.
Proctor, Tex	31, 400	Brazos River Authority, Texas.
Shelbyville, Ill	25, 000	State of Illinois.
Stillhouse Hollow, Tex	204, 900	Brazos River Authority, Texas.
Somerville, Tex	143, 900	Do.
Waco, Tex	91, 074	Do.
Do	13, 026	Waco, Tex.
West Branch, Ohio	52, 900	Mahoning and Trumbull Counties, Ohio.
Wilkesboro, N.C	33, 000	Winston-Salem and Wilkes County, N.C.
Subtotal (rounded)	3, 987, 000	
Total (rounded)	5, 585, 000	

[1] Seasonal for flood control and water supply.
[2] Completed project. Additional water supply storage to be made available following completion of Proctor Reservoir.
[3] Water supply and power storage combined.

Exhibit E–2. Irrigation Storage as of June 30, 1963

(In thousands of acre-feet)

Project	Exclusive irrigation storage	Joint-use storage
In operation		
Black Butte, Calif	----------	150
Conchas, N. Mex	279	----------
Cottage Grove, Oreg	----------	30
Detroit, Oreg	----------	300
Dorena, Oreg	----------	70
Fern Ridge, Oreg	----------	94
Folsom, Calif	----------	910
Harlan County, Nebr	150	----------
Isabella, Calif	----------	535
John Martin, Colo	367	----------
Lookout Point, Oreg	----------	337
Lucky Peak, Idaho	----------	280
Pine Flat, Calif	----------	1, 000
Lake Mendocino, Calif	----------	70
Hills Creek, Oreg	----------	200
Success, Calif	----------	75
Terminus, Calif	----------	142
Total (rounded)	800	4, 200
Under construction		
Cougar, Oreg	----------	155
Fall Creek, Oreg	----------	115
Green Peter, Oreg	----------	300
New Hogan, Calif	145	165
Total (rounded)	145	735

○